

Rhein Tech Laboratories
360 Herndon Parkway
Suite 1400
Herndon, VA 20170
<http://www.rheintech.com>

Client: UTStarcom, Inc.
Model: UTS618
FCC ID: O6YUTS-618
Standard: FCC Part 24
Date: June 10, 2003

APPENDIX A: RF EXPOSURE

Please see the SAR Evaluation that follows.

DECLARATION OF COMPLIANCE SAR EVALUATION

Test Lab

CELLTECH LABS INC.

Testing and Engineering Lab
1955 Moss Court
Kelowna, B.C.
Canada V1Y 9L3
Phone: 250-448-7047
Fax: 250-448-7046
e-mail: info@celltechlabs.com
web site: www.celltechlabs.com

Applicant Information

UTSTARCOM INC.

33 Wood Ave. South, 3rd Floor
Iselin, NJ 08830

FCC Rule Part(s):	47 CFR §2.1093
Test Procedure(s):	FCC OET Bulletin 65, Supplement C (Edition 01-01) IEEE Standard 1528-200X (Draft)
FCC Classification:	Part 24 Licensed Portable Transmitter held to ear (PCE)
FCC ID:	O6YUTS-618
Model(s):	UTS-618
Device Type:	Single-Mode PAS PHS Handset
Access Method:	TDMA (Time Division Multiple Access)
Modulation:	DQPSK (Differential Quadrature Phase Shift Keying)
Duty Cycle:	11.9 %
Tx Frequency Range:	1893.65 - 1909.95 MHz
RF Output Power Tested:	19.63 dBm EIRP (1902.35 MHz)
Antenna Type:	Non-retractable Stubby
Battery Type:	3.6V Lithium-ion, 580mAh (HZSL043048A)
Body-Worn Accessories:	Ear-Microphone
Max. SAR Measured:	0.0670 W/kg (Head) / 0.142 W/kg (Body)

Celltech Labs Inc. declares under its sole responsibility that this device was found to be in compliance with the Specific Absorption Rate (SAR) RF exposure requirements specified in FCC 47 CFR §2.1093. The device was tested in accordance with the measurement standards and procedures specified in FCC OET Bulletin 65, Supplement C, Edition 01-01 and IEEE Standard 1528-200X (Draft) for the General Population / Uncontrolled Exposure environment.

I attest to the accuracy of data. All measurements were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

This test report shall not be reproduced partially, or in full, without the prior written approval of Celltech Labs Inc. The results and statements contained in this report pertain only to the device(s) evaluated.



Russell W. Pipe
Senior Compliance Technologist
Celltech Labs Inc.



TABLE OF CONTENTS		
1.0	INTRODUCTION.....	3
2.0	DESCRIPTION OF EUT.....	3
3.0	SAR MEASUREMENT SYSTEM	4
4.0	MEASUREMENT SUMMARY.....	5
5.0	DETAILS OF SAR EVALUATION.....	6-7
6.0	EVALUATION PROCEDURES.....	8-9
7.0	SYSTEM PERFORMANCE CHECK.....	10
8.0	EQUIVALENT TISSUES.....	11
9.0	SAR LIMITS.....	11
10.0	SYSTEM SPECIFICATIONS.....	12
11.0	PROBE SPECIFICATION.....	13
12.0	SAM PHANTOM.....	13
13.0	DEVICE HOLDER.....	13
14.0	TEST EQUIPMENT LIST.....	14
15.0	MEASUREMENT UNCERTAINTIES.....	15-16
16.0	REFERENCES.....	17
	APPENDIX A - SAR MEASUREMENT DATA.....	18
	APPENDIX B - SYSTEM PERFORMANCE CHECK DATA.....	19
	APPENDIX C - SYSTEM VALIDATION.....	20
	APPENDIX D - PROBE CALIBRATION.....	21
	APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS.....	22
	APPENDIX F - SAM PHANTOM CERTIFICATE OF CONFORMITY.....	23
	APPENDIX G - SAR TEST SETUP & EUT PHOTOGRAPHS.....	24

1.0 INTRODUCTION

This measurement report shows that the UTSTARCOM INC. Model: UTS-618 Single-Mode PAS PHS TDMA Handset FCC ID: O6YUTS-618 complies with the RF exposure requirements specified in FCC 47 CFR §2.1093 (see reference [1]) (General Population / Uncontrolled Exposure environment). The test procedures described in FCC OET Bulletin 65, Supplement C, Edition 01-01 (see reference [2]), and IEEE Standard 1528-200X (Draft) (see reference [3]) were employed. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used, and the various provisions of the rules are included within this test report.

2.0 DESCRIPTION of Equipment Under Test (EUT)

EUT Type	Single-Mode PAS PHS Handset
FCC Equipment Class	Licensed Portable Transmitter Held to Ear (PCE)
FCC Rule Part(s)	47 CFR §2.1093
Test Procedure(s)	FCC OET Bulletin 65, Supplement C (01-01) IEEE Standard 1528-200X (Draft)
FCC ID	O6YUTS-618
Model No.(s)	UTS-618
Serial No.	Pre-production unit
Tx Frequency Range	1893.65 - 1909.95 MHz
RF Output Power Tested	19.63 dBm EIRP (1902.35 MHz)
Access Method	TDMA (Time Division Multiple Access)
Modulation	DQPSK (Differential Quadrature Phase Shift Keying)
Duty Cycle	11.9 %
Battery Type(s)	3.6V Lithium-ion, 580 mAh (HZSL043048A)
Antenna Type	Non-retractable Stubby
Body-Worn Accessories Tested	Ear-Microphone

3.0 SAR MEASUREMENT SYSTEM

Celltech Labs SAR measurement facility utilizes the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, specific anthropomorphic mannequin (SAM) phantom, and various planar phantoms for face-held and/or body-worn SAR evaluations. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The DAE3 utilizes a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.



DASY3 SAR Measurement System with SAM Phantom

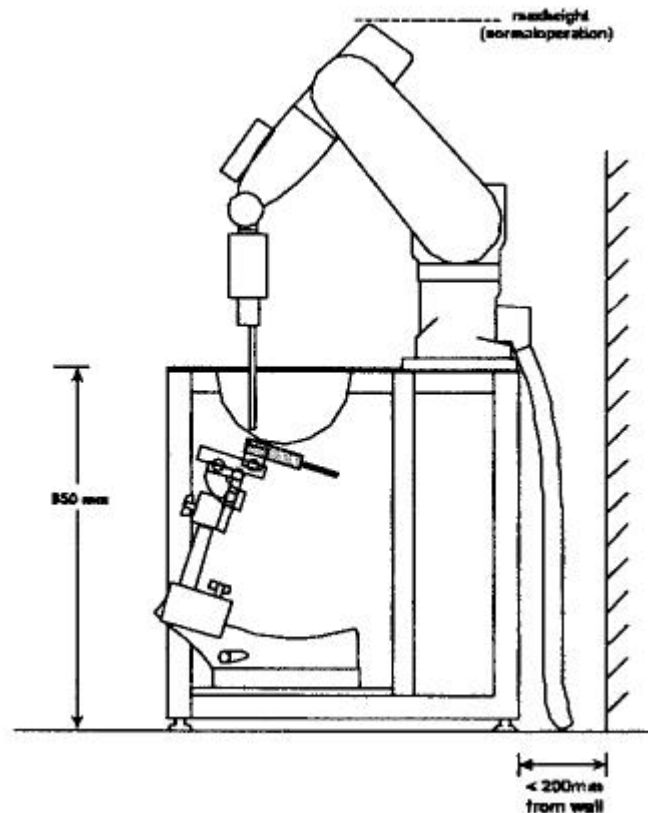


Figure 1. DASY3 Compact Version - Side View

4.0 MEASUREMENT SUMMARY

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum SAR location of the EUT are reported in Appendix A.

SAR EVALUATION RESULTS								
Freq. (MHz)	Channel	Test Mode	RF Output Power (EIRP)	Battery Type	Antenna Position	Phantom Section	Test Position	Measured SAR 1g (W/kg)
1902.35	25	TDMA	19.63 dBm	Standard	Fixed	Left Ear	Cheek/Touch	0.0641
1902.35	25	TDMA	19.63 dBm	Standard	Fixed	Left Ear	Ear/Tilt (15°)	0.0076
1902.35	25	TDMA	19.63 dBm	Standard	Fixed	Left Ear	Ear/Tilt (15°)	0.0058
1902.35	25	TDMA	19.63 dBm	Standard	Fixed	Right Ear	Cheek/Touch	0.0670
1902.35	25	TDMA	19.63 dBm	Standard	Fixed	Right Ear	Ear/Tilt (15°)	0.0081
1902.35	25	TDMA	19.63 dBm	Standard	Fixed	Right Ear	Ear/Tilt (15°)	0.0052
1902.35	25	TDMA	19.63 dBm	Standard	Fixed	Planar	Body (0.0 cm)	0.142
ANSI / IEEE C95.1 1992 - SAFETY LIMIT BRAIN / BODY: 1.6 W/kg (averaged over 1 gram) Spatial Peak - Uncontrolled Exposure / General Population								
Measured Tissue Simulant		1900MHz Brain		1900MHz Body		Ambient Temperature		25.5 °C
		IEEE Target	Measured	IEEE Target	Measured	Fluid Temperature		23.4 °C
Dielectric Constant ϵ_r		40.0 ±5%	38.4	53.3 ±5%	51.3	Fluid Depth		≥ 15 cm
Conductivity σ (mho/m)		1.40 ±5%	1.40	1.52 ±5%	1.53	Relative Humidity		58 %
ρ (Kg/m³)		1000				Atmospheric Pressure		101.8 kPa

Note(s):

1. If the SAR measurements performed at the middle channel were ≥ 3dB below the SAR limit; SAR evaluation for the low and high channels was optional (per FCC OET Bulletin 65, Supplement C, Edition 01-01 - see reference [2]).
2. Secondary hotspot evaluations were performed at the left and right ear tilt positions to show SAR levels within 3 dB of the primary.
3. The ambient and fluid temperatures were measured prior to, and during, the fluid dielectric parameter check and the SAR evaluation. The temperatures listed in the table above were consistent for all measurement periods.
4. The dielectric properties of the simulated fluids were verified prior to the evaluation using an 85070C Dielectric Probe Kit and an 8753E Network Analyzer (see Appendix E for printout of measured fluid dielectric parameters).

5.0 DETAILS OF SAR EVALUATION

The UTSTARCOM INC. Model: UTS-618 Single-Mode PAS PHS TDMA Handset FCC ID: O6YUTS-618 was found to be compliant for localized Specific Absorption Rate (SAR) based on the test provisions and conditions described below. The detailed test setup photographs are shown in Appendix G.

- 1) The EUT was tested in an ear-held configuration at both the left and right head sections of the SAM phantom at the center channel of the operating band. If the SAR value at the center channel for each test configuration (left ear, right ear, cheek/touch, ear/tilt) was 3dB or greater below the SAR limit, measurements at the low and high channels were optional for those test configurations (including body SAR) per FCC OET Bulletin 65, Supplement C, Edition 01-01 (see reference [2]).
- a) The handset was placed in the device holder in a normal operating position with the test device reference point located along the vertical centerline on the front of the device aligned to the ear reference point, with the center of the earpiece touching the center of the ear spacer of the SAM phantom.
- b) With the handset positioned parallel to the cheek, the test device reference point was aligned to the ear reference point on the head phantom, and the vertical centerline was aligned to the phantom reference plane (initial ear position).
- c) While maintaining the three alignments, the body of the handset was gradually adjusted to each of the following test positions:
 - Cheek/Touch Position: the handset was brought toward the mouth of the head phantom by pivoting against the ear reference point until any point of the mouthpiece or keypad touched the phantom.

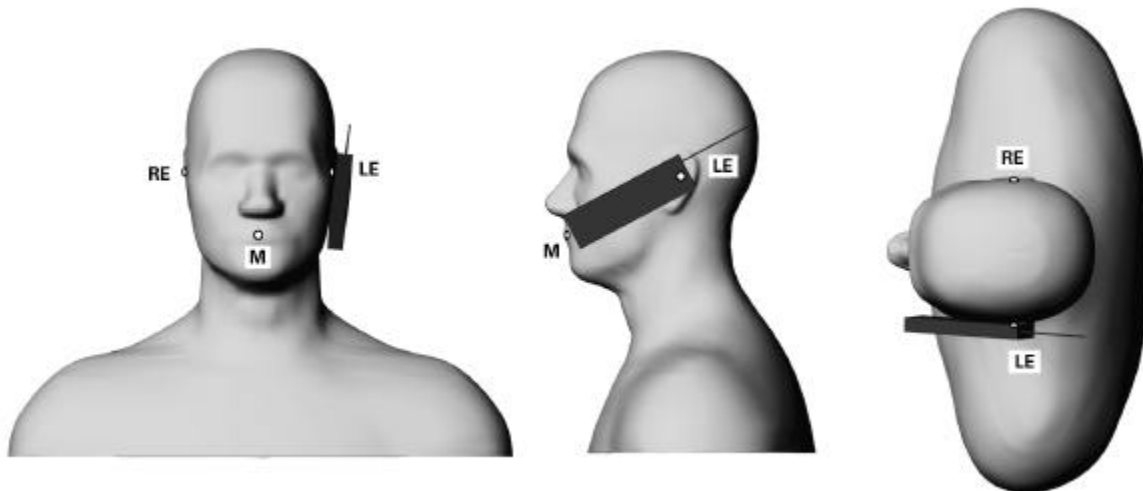


Figure 2. Phone position 1 - “cheek” or “touch” position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated (Shoulders are shown for illustration only).

- Ear/Tilt Position: With the phone aligned in the Cheek/Touch position, the handset was tilted away from the mouth with respect to the test device reference point by 15 degrees.

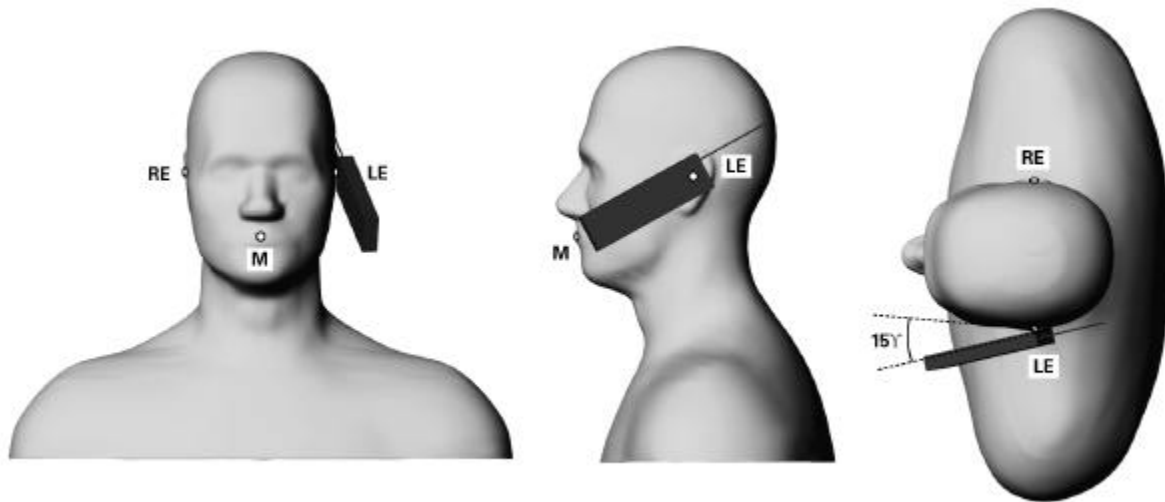


Figure 3. Phone position 2 - "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated (Shoulders are shown for illustration only).

- 2) The EUT was tested in a body-worn configuration with the back of the device placed parallel to, and touching, the outer surface of the SAM phantom (planar section). An ear-microphone accessory was connected to the EUT for the duration of the test.
- 3) The EUT was placed into test mode using internal software controlled by the keypad.
- 4) The EUT was tested in TDMA mode at a duty cycle of 11.9% and a crest factor of 8.4.
- 5) The conducted power level of the EUT could not be measured for the SAR evaluation. The EUT was evaluated for SAR at the maximum conducted power level preset by the manufacturer.
- 6) The EUT was evaluated for SAR at the maximum EIRP measured by signal substitution method.
- 7) The power drift measured by the DASY system for the duration of each test was within +/- 5%.
- 8) The EUT was tested with a fully charged battery.

6.0 EVALUATION PROCEDURES

- a. (i) The evaluation was performed in the applicable area of the phantom depending on the type of device being tested. For devices held to the ear during normal operation, both the left and right ear positions were evaluated in accordance with FCC OET Bulletin 65, Supplement C (Edition 01-01) using the SAM phantom.
- (ii) For body-worn and face-held devices a planar phantom was used.
- b. The SAR was determined by a pre-defined procedure within the DASY3 software. Upon completion of a reference and optical surface check, the exposed region of the phantom was scanned near the inner surface with a grid spacing of 15mm x 15mm.
- c. Based on the area scan data, the area of maximum absorption was determined by spline interpolation. Around this point, a volume of 40 x 40 x 35 mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points.
- d. The 1g and 10g spatial peak SAR was determined as follows:
 1. The first step was an extrapolation to find the points between the dipole center of the probe and the surface of the phantom. This data cannot be measured, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.4 mm (see probe calibration document in Appendix D). The extrapolation was based on a least square algorithm [W. Gander, Computermathematik, p.168-180] (see reference [4]). Through the points in the first 3 cm in each z-axis, polynomials of the fourth order were calculated. These polynomials were then used to evaluate the points between the surface and the probe tip.
 2. The next step used 3D-spline interpolation to get all points within the measured volume in a 1mm grid (35000 points). The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff] (see reference [4]).
 3. The maximal interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-spline interpolation algorithm. 8000 points (20x20x20) were interpolated to calculate the average.

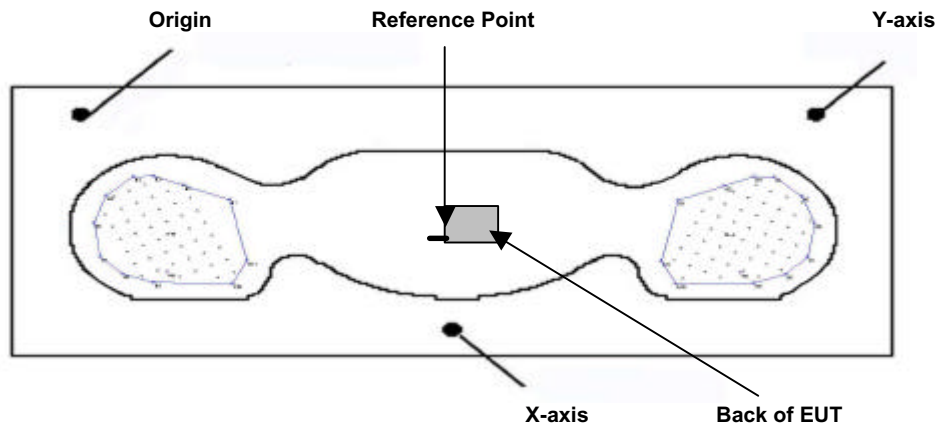


Figure 4. Device Positioning & Reference Point (Body SAR - Back of EUT)

EVALUATION PROCEDURES (Cont.)

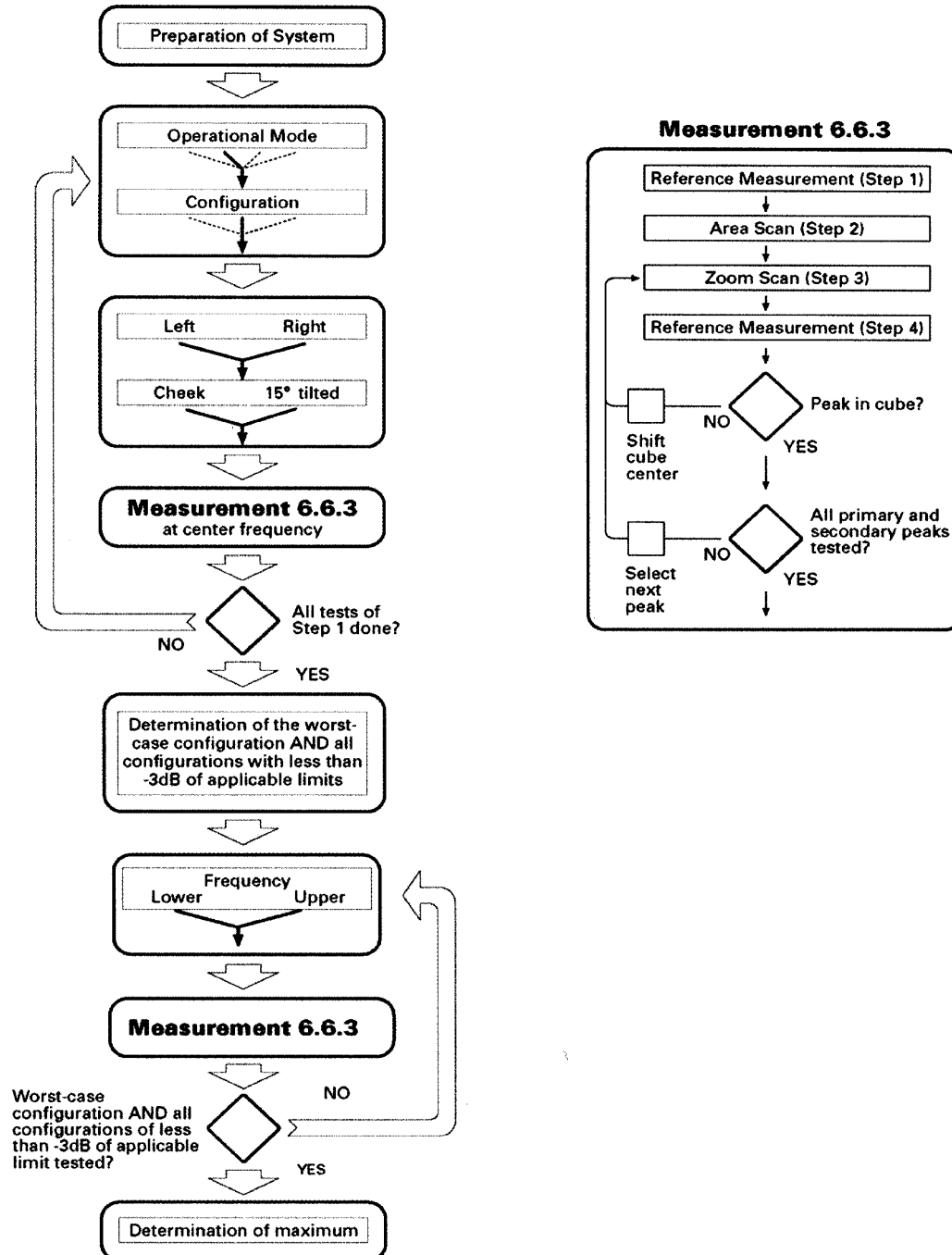


Figure 5. Flow Chart of the recommended practices and procedures per IEEE Std 1528-200X - Draft (see reference [3])

7.0 SYSTEM PERFORMANCE CHECK

Prior to the SAR evaluation a system check was performed at the planar section of the SAM phantom with an 1800MHz dipole (see Appendix C for system validation procedures). Prior to the system check the dielectric parameters of the simulated tissue fluid were measured using an HP 85070C Dielectric Probe Kit and an HP 8753E Network Analyzer (see Appendix E for printout of measured fluid dielectric parameters). A forward power of 250 mW was applied to the dipole and the system was verified to a tolerance of $\pm 10\%$ (see Appendix B for system check test plot).

SYSTEM PERFORMANCE CHECK											
Test Date	Equiv. Tissue (1800MHz)	SAR 1g (W/kg)		Dielectric Constant ϵ_r		Conductivity σ (mho/m)		ρ (Kg/m ³)	Ambient Temp.	Fluid Temp.	Fluid Depth
		IEEE Target	Measured	IEEE Target	Measured	IEEE Target	Measured				
06/06/03	Brain	9.53 $\pm 10\%$	9.25	40.0 $\pm 5\%$	40.3	1.40 $\pm 5\%$	1.35	1000	25.5 °C	23.4 °C	≥ 15 cm

Note(s):

1. The ambient and fluid temperatures were measured prior to, and during, the fluid dielectric parameter check and the system performance check. The temperatures listed in the table above were consistent for all measurement periods.

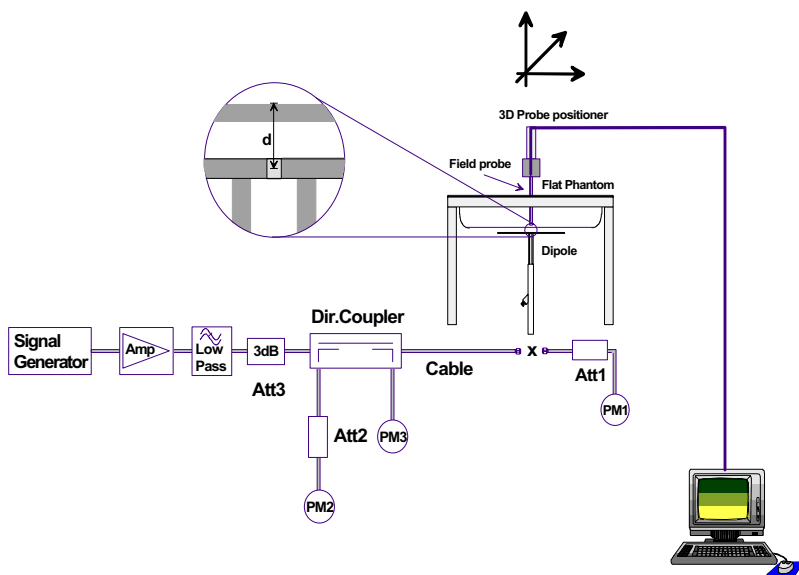


Figure 6. System Check Setup Diagram



1800MHz System Check Setup

8.0 SIMULATED TISSUES

The 1800MHz and 1900MHz simulated tissue mixtures consist of Glycol-monobutyl, water, and salt. The fluid was prepared according to standardized procedures and measured for dielectric parameters (permittivity and conductivity).

TISSUE MIXTURES			
INGREDIENT	1800MHz Brain (System Check)	1900MHz Brain (EUT Evaluation)	1900MHz Body (EUT Evaluation)
Water	548.0 g	552.40 g	716.60 g
Glycol Monobutyl	448.5 g	444.52 g	300.70 g
Salt	3.20 g	3.06 g	3.10 g

9.0 SAR SAFETY LIMITS

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

Notes:

1. Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.
2. Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

10.0 ROBOT SYSTEM SPECIFICATIONS

Specifications

POSITIONER: Stäubli Unimation Corp. Robot Model: RX60L
Repeatability: 0.02 mm
No. of axis: 6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor: Pentium III
Clock Speed: 450 MHz
Operating System: Windows NT
Data Card: DASY3 PC-Board

Data Converter

Features: Signal Amplifier, multiplexer, A/D converter, and control logic
Software: DASY3 software
Connecting Lines: Optical downlink for data and status info.
Optical uplink for commands and clock

PC Interface Card

Function: 24 bit (64 MHz) DSP for real time processing
Link to DAE3
16-bit A/D converter for surface detection system
serial link to robot
direct emergency stop output for robot

E-Field Probe

Model: ET3DV6
Serial No.: 1387
Construction: Triangular core fiber optic detection system
Frequency: 10 MHz to 6 GHz
Linearity: ± 0.2 dB (30 MHz to 3 GHz)

Phantom

Type: SAM V4.0C
Shell Material: Fiberglass
Thickness: 2.0 ± 0.1 mm
Volume: Approx. 20 liters

11.0 PROBE SPECIFICATION (ET3DV6)

Construction:	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. glycol)
Calibration:	In air from 10 MHz to 2.5 GHz In brain simulating tissue at frequencies of 900 MHz and 1.8 GHz (accuracy $\pm 8\%$)
Frequency:	10 MHz to >6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity:	± 0.2 dB in brain tissue (rotation around probe axis) ± 0.4 dB in brain tissue (rotation normal to probe axis)
Dynamic Range:	5 μ W/g to >100 mW/g; Linearity: ± 0.2 dB
Surface Detect.:	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces
Dimensions:	Overall length: 330 mm Tip length: 16 mm Body diameter: 12 mm Tip diameter: 6.8 mm Distance from probe tip to dipole centers: 2.7 mm
Application:	General dosimetry up to 3 GHz Compliance tests of mobile phone



ET3DV6 E-Field Probe

12.0 SAM PHANTOM V4.0C

The SAM phantom V4.0C is a fiberglass shell phantom with a 2.0 mm shell thickness for left and right head and flat planar area integrated in a wooden table. The shape of the fiberglass shell corresponds to the phantom defined by SCC34-SC2. The device holder positions are adjusted to the standard measurement positions in the three sections.



SAM Phantom V4.0C

13.0 DEVICE HOLDER

The DASY3 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.



Device Holder

14.0 TEST EQUIPMENT LIST

SAR MEASUREMENT SYSTEM		
TEST EQUIPMENT	SERIAL NO.	CALIBRATION DATE
Schmid & Partner DASY3 System	-	-
-Robot	599396-01	N/A
-ET3DV6 E-Field Probe	1387	Feb 2003
-300MHz Validation Dipole	135	Oct 2002
-450MHz Validation Dipole	136	Oct 2002
-900MHz Validation Dipole	054	June 2001
-1800MHz Validation Dipole	247	June 2001
-2450MHz Validation Dipole	150	Oct 2002
-SAM Phantom V4.0C	N/A	N/A
-Planar Phantom	N/A	N/A
-Validation Planar Phantom	N/A	N/A
HP 85070C Dielectric Probe Kit	N/A	N/A
Gigatronics 8651A Power Meter	8650137	April 2003
Gigatronics 8652A Power Meter	1835267	April 2003
Power Sensor 80701A	1833542	Feb 2003
Power Sensor 80701A	1833699	April 2003
HP E4408B Spectrum Analyzer	US39240170	Dec 2002
HP 8594E Spectrum Analyzer	3543A02721	Feb 2003
HP 8753E Network Analyzer	US38433013	Feb 2003
HP 8648D Signal Generator	3847A00611	Feb 2003
Amplifier Research 5S1G4 Power Amplifier	26235	N/A

15.0 MEASUREMENT UNCERTAINTIES

UNCERTAINTY BUDGET FOR DEVICE EVALUATION						
Error Description	Uncertainty Value $\pm\%$	Probability Distribution	Divisor	c_i 1g	Standard Uncertainty $\pm\%$ (1g)	v_i or v_{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.7	Rectangular	$\sqrt{3}$	$(1-c_p)$	± 1.9	∞
Spherical isotropy of the probe	± 9.6	Rectangular	$\sqrt{3}$	(c_p)	± 3.9	∞
Spatial resolution	± 0.0	Rectangular	$\sqrt{3}$	1	± 0.0	∞
Boundary effects	± 5.5	Rectangular	$\sqrt{3}$	1	± 3.2	∞
Probe linearity	± 4.7	Rectangular	$\sqrt{3}$	1	± 2.7	∞
Detection limit	± 1.0	Rectangular	$\sqrt{3}$	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	± 0.5	∞
Integration time	± 1.4	Rectangular	$\sqrt{3}$	1	± 0.8	∞
RF ambient conditions	± 3.0	Rectangular	$\sqrt{3}$	1	± 1.7	∞
Mech. constraints of robot	± 0.4	Rectangular	$\sqrt{3}$	1	± 0.2	∞
Probe positioning	± 2.9	Rectangular	$\sqrt{3}$	1	± 1.7	∞
Extrapolation & integration	± 3.9	Rectangular	$\sqrt{3}$	1	± 2.3	∞
Test Sample Related						
Device positioning	± 6.0	Normal	$\sqrt{3}$	1	± 6.7	12
Device holder uncertainty	± 5.0	Normal	$\sqrt{3}$	1	± 5.9	8
Power drift	± 5.0	Rectangular	$\sqrt{3}$		± 2.9	∞
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	$\sqrt{3}$	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid conductivity (measured)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Combined Standard Uncertainty					± 13.3	
Expanded Uncertainty (k=2)					± 26.6	

Measurement Uncertainty Table in accordance with IEEE Std 1528-200X (Draft - see reference [3])

MEASUREMENT UNCERTAINTIES (Cont.)

UNCERTAINTY BUDGET FOR SYSTEM VALIDATION						
Error Description	Uncertainty Value $\pm\%$	Probability Distribution	Divisor	c_i 1g	Standard Uncertainty $\pm\%$ (1g)	v_i or v_{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.7	Rectangular	$\sqrt{3}$	$(1-c_p)$	± 1.9	∞
Spherical isotropy of the probe	± 9.6	Rectangular	$\sqrt{3}$	(c_p)	± 3.9	∞
Spatial resolution	± 0.0	Rectangular	$\sqrt{3}$	1	± 0.0	∞
Boundary effects	± 5.5	Rectangular	$\sqrt{3}$	1	± 3.2	∞
Probe linearity	± 4.7	Rectangular	$\sqrt{3}$	1	± 2.7	∞
Detection limit	± 1.0	Rectangular	$\sqrt{3}$	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	± 0.5	∞
Integration time	± 1.4	Rectangular	$\sqrt{3}$	1	± 0.8	∞
RF ambient conditions	± 3.0	Rectangular	$\sqrt{3}$	1	± 1.7	∞
Mech. constraints of robot	± 0.4	Rectangular	$\sqrt{3}$	1	± 0.2	∞
Probe positioning	± 2.9	Rectangular	$\sqrt{3}$	1	± 1.7	∞
Extrapolation & integration	± 3.9	Rectangular	$\sqrt{3}$	1	± 2.3	∞
Dipole						
Dipole Axis to Liquid Distance	± 2.0	Rectangular	$\sqrt{3}$	1	± 1.2	∞
Input Power	± 4.7	Rectangular	$\sqrt{3}$	1	± 2.7	∞
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	$\sqrt{3}$	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid conductivity (measured)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Combined Standard Uncertainty						
					± 9.9	
Expanded Uncertainty (k=2)						
					± 19.8	

Measurement Uncertainty Table in accordance with IEEE Std 1528-200X (Draft - see reference [3])

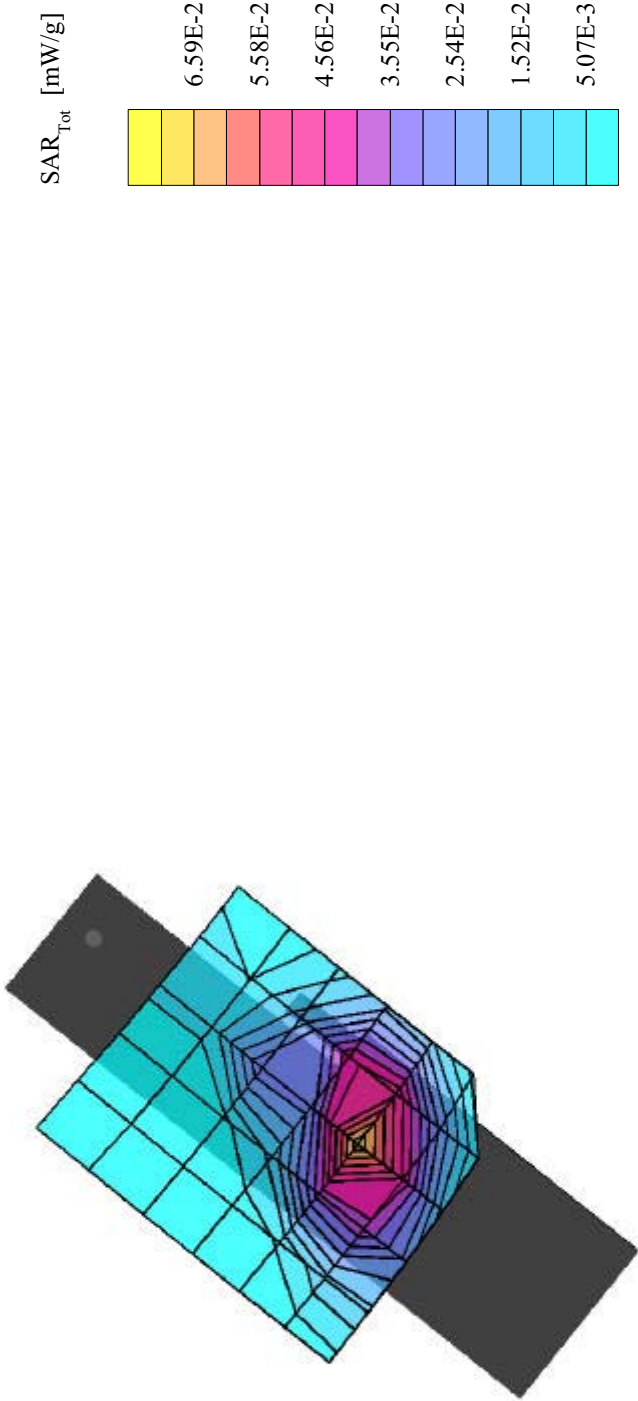
16.0 REFERENCES

- [1] Federal Communications Commission, "Radiofrequency radiation exposure evaluation: portable devices", Rule Part 47 CFR §2.1093: 1999.
- [2] Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C.: June 2001.
- [3] IEEE Standards Coordinating Committee 34, Std 1528-200X, "DRAFT Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques".
- [4] W. Gander, *Computermathematick*, Birkhaeuser, Basel: 1992.

APPENDIX A - SAR MEASUREMENT DATA

UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Left Head Section; Position: (90°,180°)
Probe: ET3DV6 - SN1387; ConvF(5.20,5.20,5.20); Crest factor: 8.4
1900 MHz Brain: $\sigma = 1.40$ mho/m $\epsilon_r = 38.4$ $\rho = 1.00$ g/cm³
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.13 dB
SAR (1g): 0.0641 mW/g, SAR (10g): 0.0376 mW/g

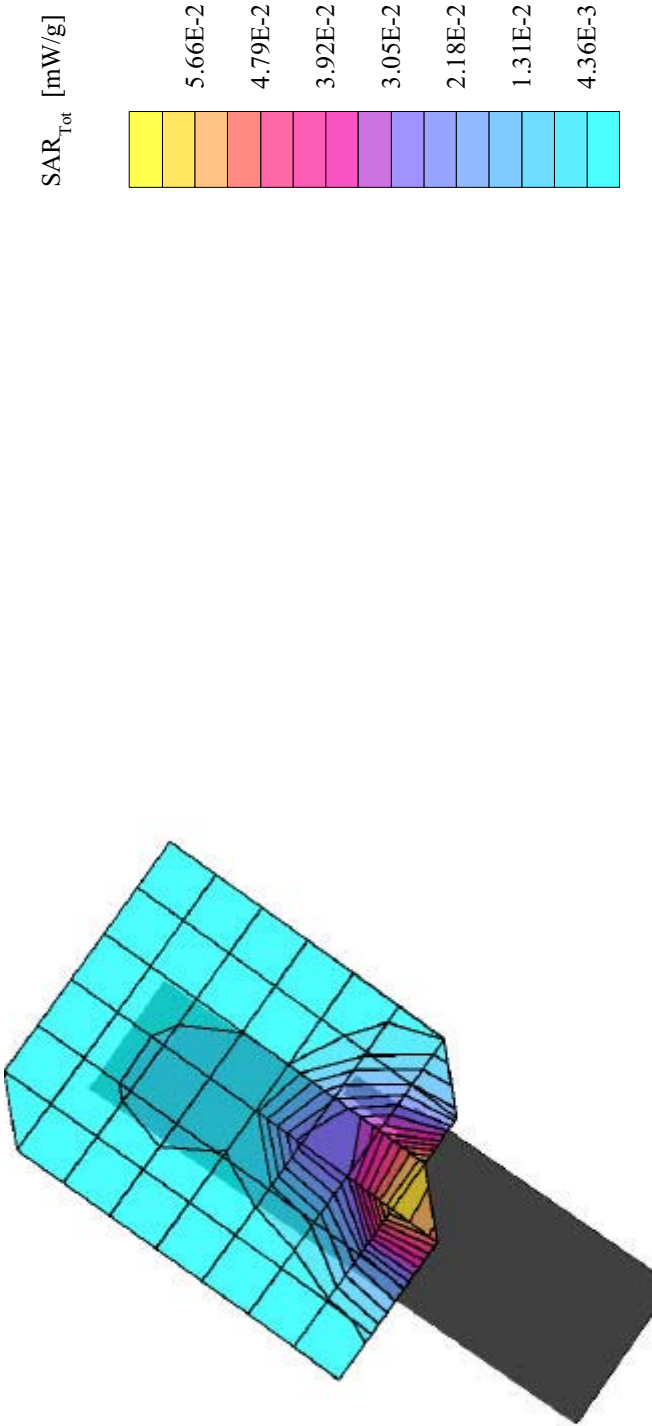
Head SAR - Left Ear - Cheek/Touch Position
UTS-618 PAS PHS Handset
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003



UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Left Head Section; Position: (90°, 65°)
Probe: ET3DV6 - SN1387; ConvF(5.20,5.20,5.20); Crest factor: 8.4
1900 MHz Brain: $\sigma = 1.40$ mho/m $\epsilon_r = 38.4$ $\rho = 1.00$ g/cm³
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0

Head SAR - Left Ear - Cheek/Touch Position
UTS-618 PAS PHS Handset
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003

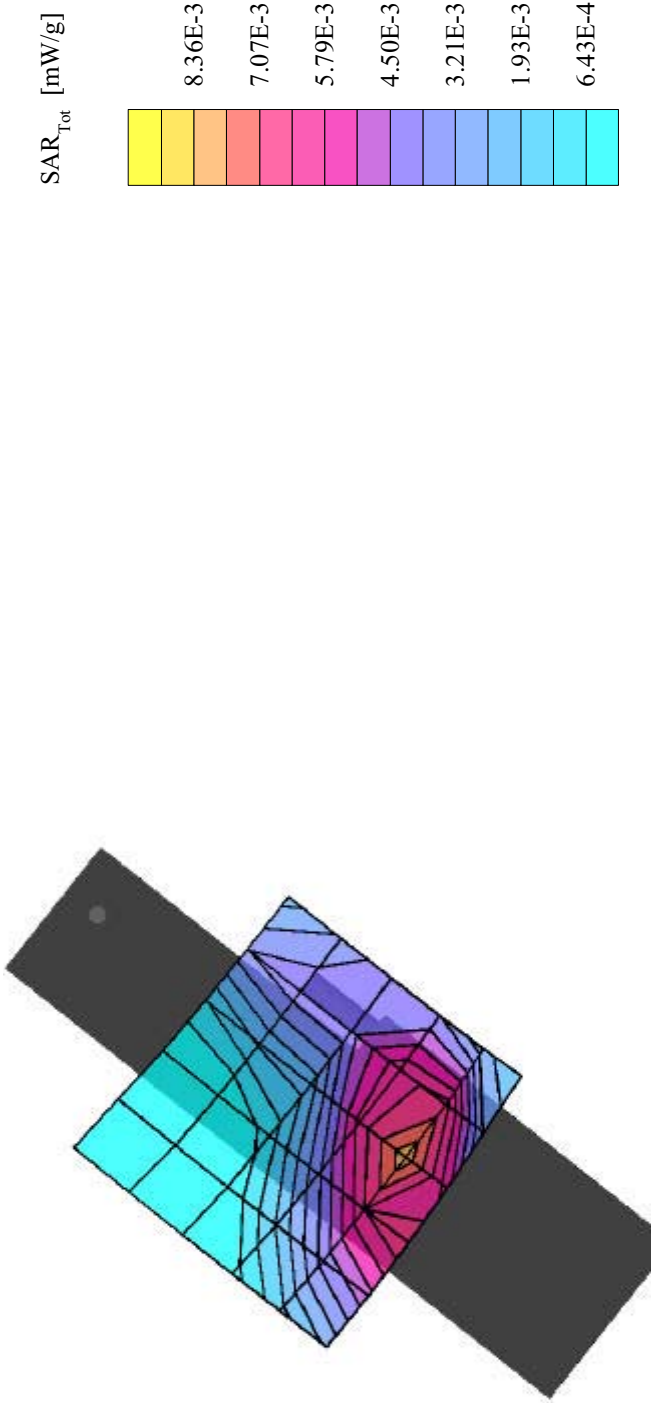
Secondary Coarse Scan (LCD Section)



UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Left Head Section; Position: (90°, 180°)
Probe: ET3DV6 - SN1387; ConvF(5.20,5.20,5.20); Crest factor: 8.4
1900 MHz Brain: $\sigma = 1.40$ mho/m $\epsilon_r = 38.4$ $\rho = 1.00$ g/cm³
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.01 dB
SAR (1g): 0.0076 mW/g, SAR (10g): 0.0050 mW/g

Head SAR - Left Ear - 15° Tilt Position
UTS-618 PAS PHS Handset
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003

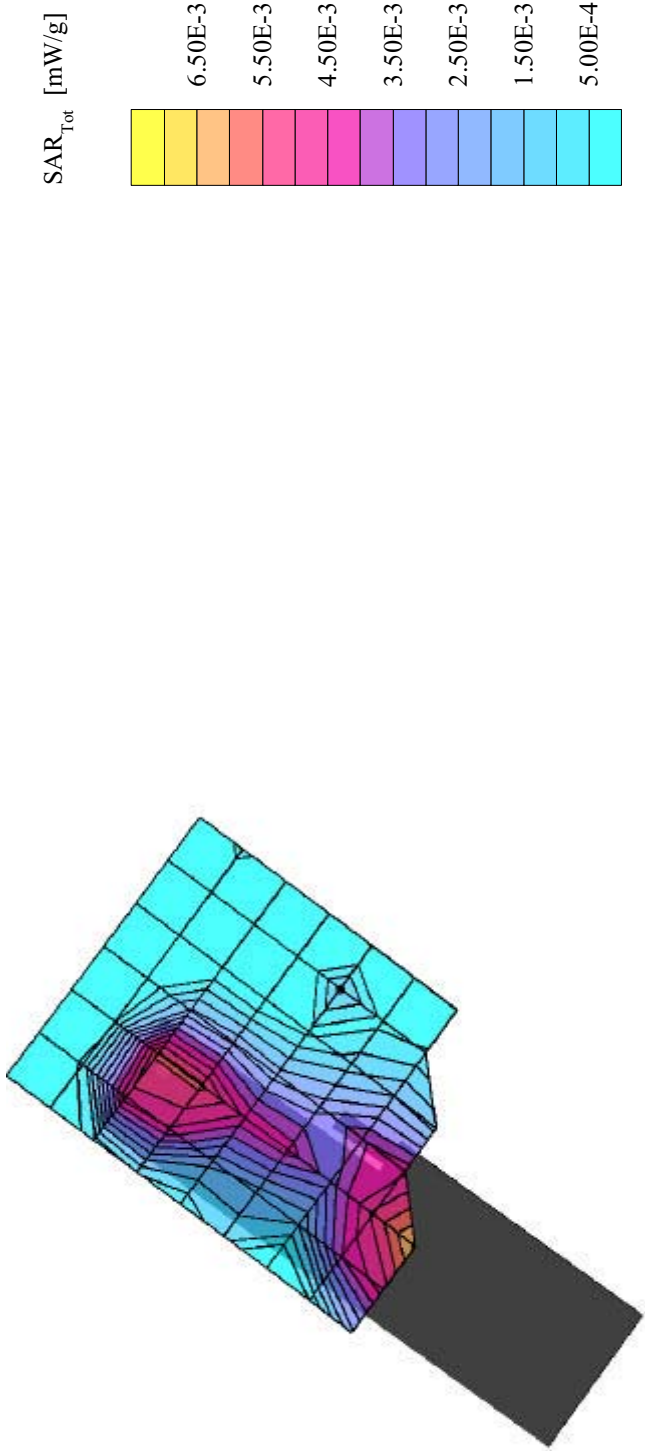
PRIMARY HOTSPOT EVALUATION (Keypad Section)



UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Left Head Section; Position: (90°,65°)
Probe: ET3DV6 - SN1387; ConvF(5.20,5.20,5.20); Crest factor: 8.4
1900 MHz Brain: $\sigma = 1.40$ mho/m $\epsilon_r = 38.4$ $\rho = 1.00$ g/cm³
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: 0.15 dB
SAR (1g): 0.0058 mW/g, SAR (10g): 0.0034 mW/g

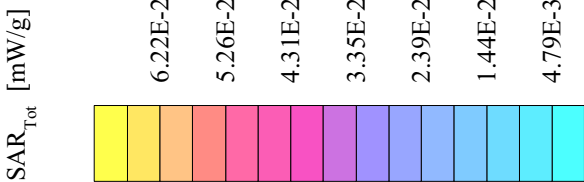
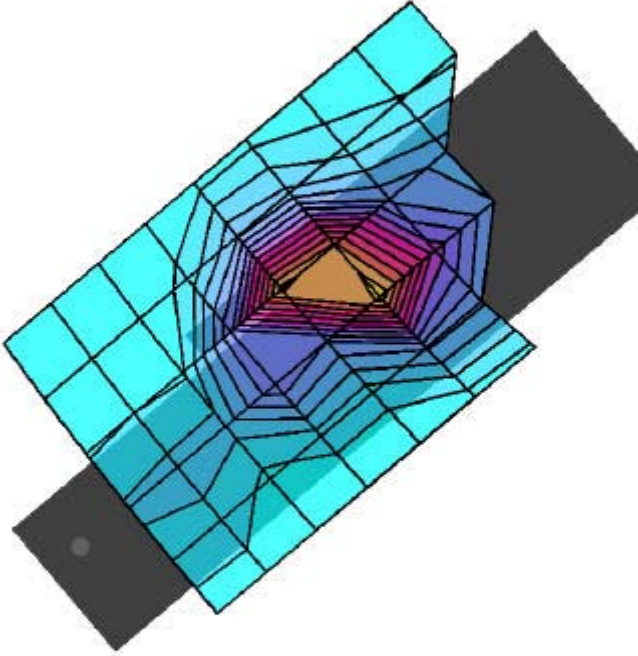
Head SAR - Left Ear - 15° Tilt Position
UTS-618 PAS PHS Handset
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003

SECONDARY HOTSPOT EVALUATION (LCD Section)



UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Right Head Section; Position: (65°,230°)
Probe: ET3DV6 - SN1387; ConvF(5.20,5.20,5.20); Crest factor: 8.4
1900 MHz Brain: $\sigma = 1.40$ mho/m $\epsilon_r = 38.4$ $\rho = 1.00$ g/cm³
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.09 dB
SAR (1g): 0.0670 mW/g, SAR (10g): 0.0360 mW/g

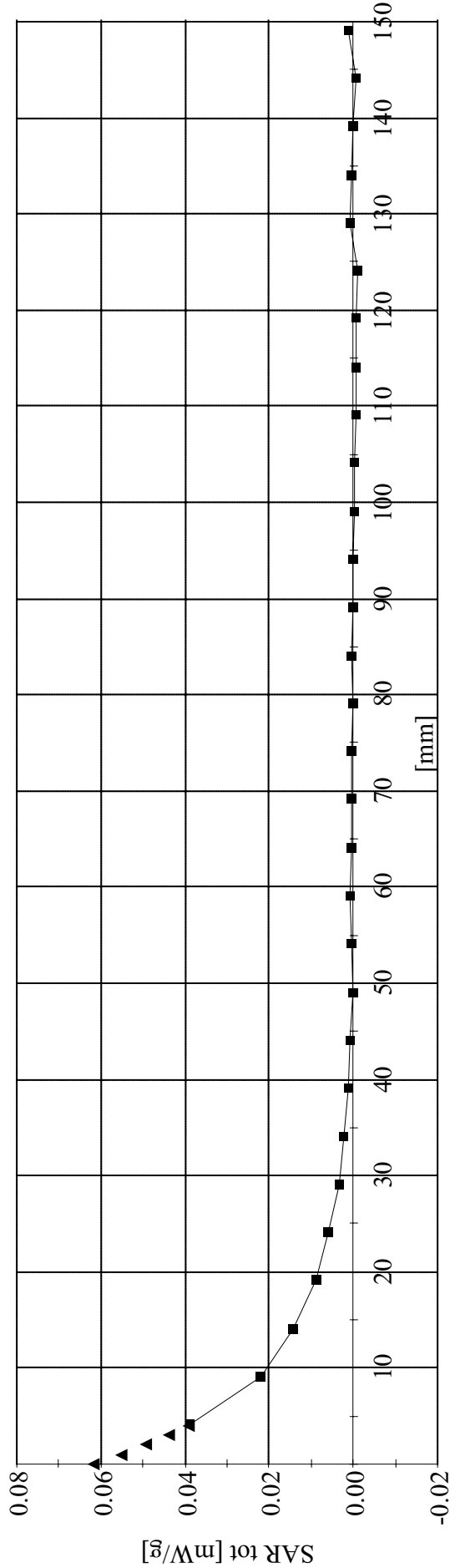
Head SAR - Right Ear - Cheek/Touch Position
UTS-618 PAS PHS Handset
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003



UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Right Head Section
Probe: ET3DV6 - SNI387; ConvF(5.20,5.20,5.20); Crest factor: 8.4
1900 MHz Brain: $\sigma = 1.40$ mho/m $\epsilon_r = 38.4$ $\rho = 1.00$ g/cm³

Z-Axis Extrapolation at Peak SAR Location

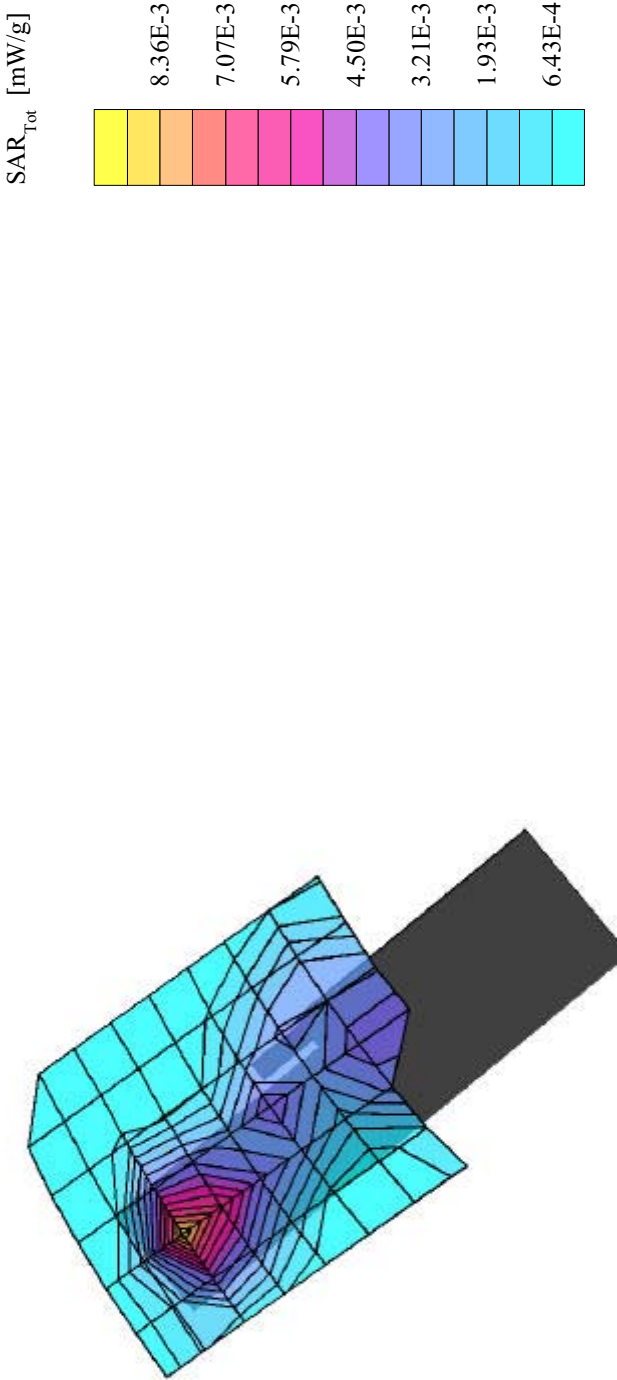
Head SAR - Right Ear - Cheek/Touch Position
UTS-618 PAS PHS Handset
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003



UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Right Head Section; Position: (65°,300°)
Probe: ET3DV6 - SN1387; ConvF(5.20,5.20,5.20); Crest factor: 8.4
1900 MHz Brain: $\sigma = 1.40$ mho/m $\epsilon_r = 38.4$ $\rho = 1.00$ g/cm³
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.09 dB
SAR (1g): 0.0081 mW/g, SAR (10g): 0.0041 mW/g

Head SAR - Right Ear - 15° Tilt Position
UTS-618 PAS PHS Handset
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003

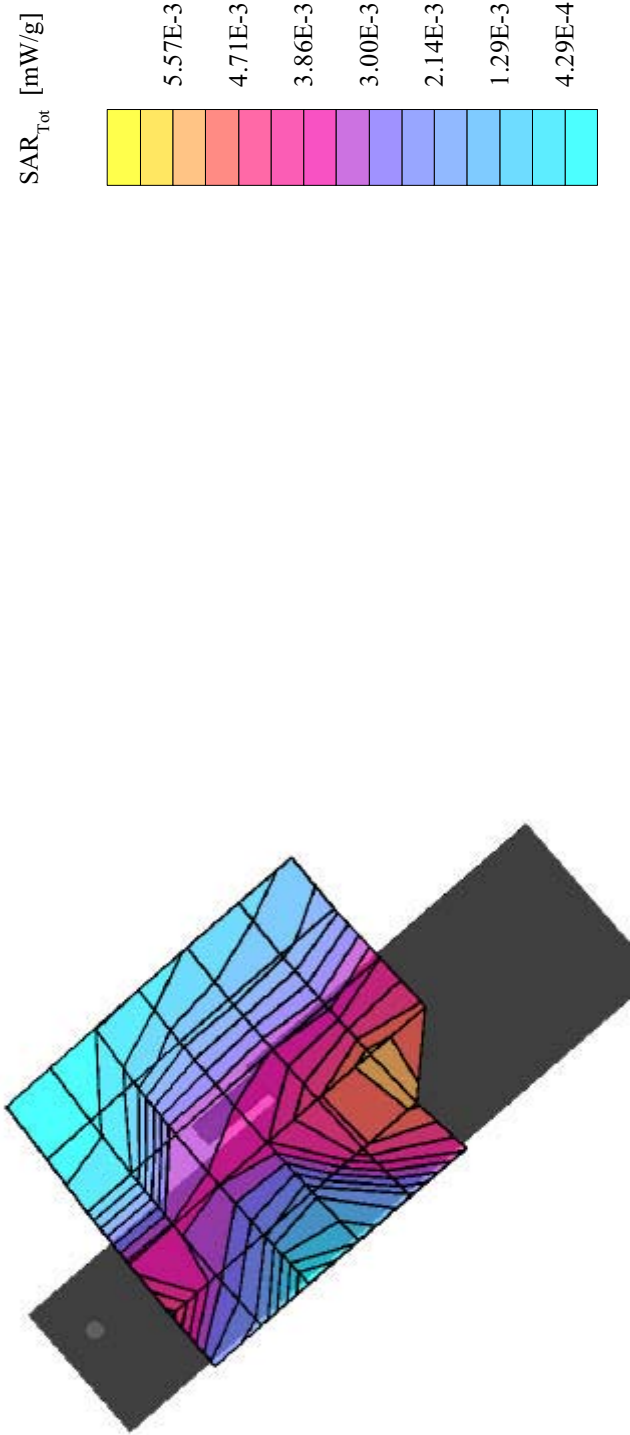
PRIMARY HOTSPOT EVALUATION (LCD Section)



UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Right Head Section; Position: (65°,230°)
Probe: ET3DV6 - SN1387; ConvF(5.20,5.20,5.20); Crest factor: 8.4
1900 MHz Brain: $\sigma = 1.40$ mho/m $\epsilon_r = 38.4$ $\rho = 1.00$ g/cm³
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.14 dB
SAR (1g): 0.0052 mW/g, SAR (10g): 0.0038 mW/g

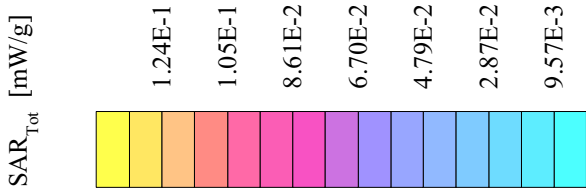
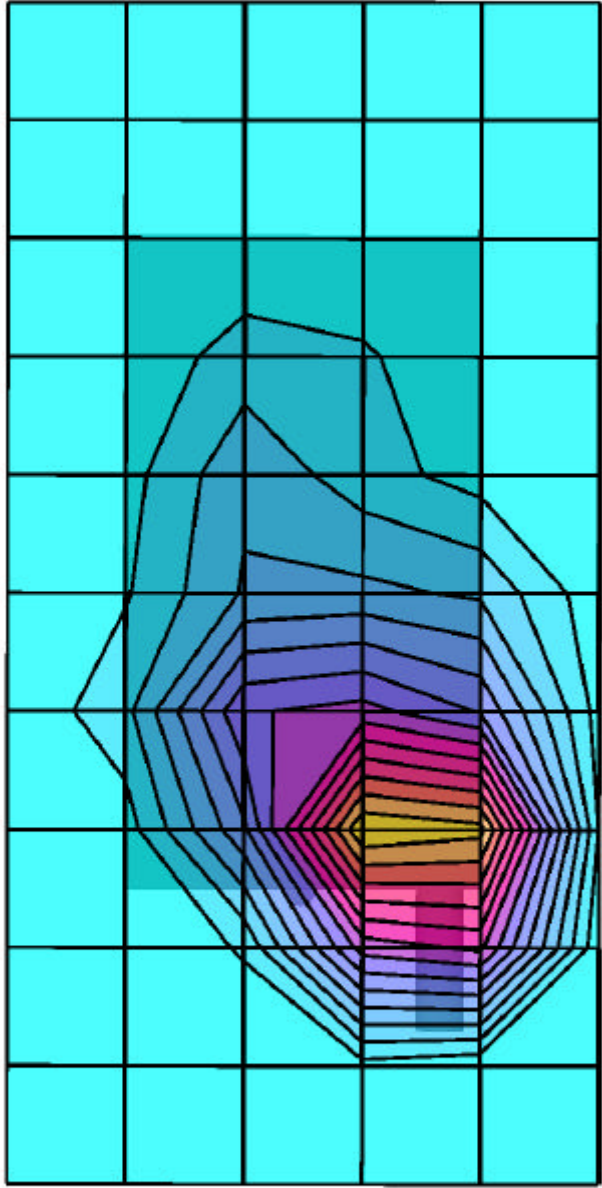
Head SAR - Right Ear - 15° Tilt Position
UTS-618 PAS PHS Handset
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003

SECONDARY HOTSPOT EVALUATION (Keypad Section)



UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Flat Section; Position: (270°, 90°)
Probe: ET3DV6 - SN1387; ConvF(4.90,4.90); Crest factor: 8.4
1900 MHz Muscle: $\sigma = 1.53 \text{ mho/m}$ $\epsilon_r = 51.3$ $\rho = 1.00 \text{ g/cm}^3$
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.03 dB
SAR (1g): 0.142 mW/g, SAR (10g): 0.0683 mW/g

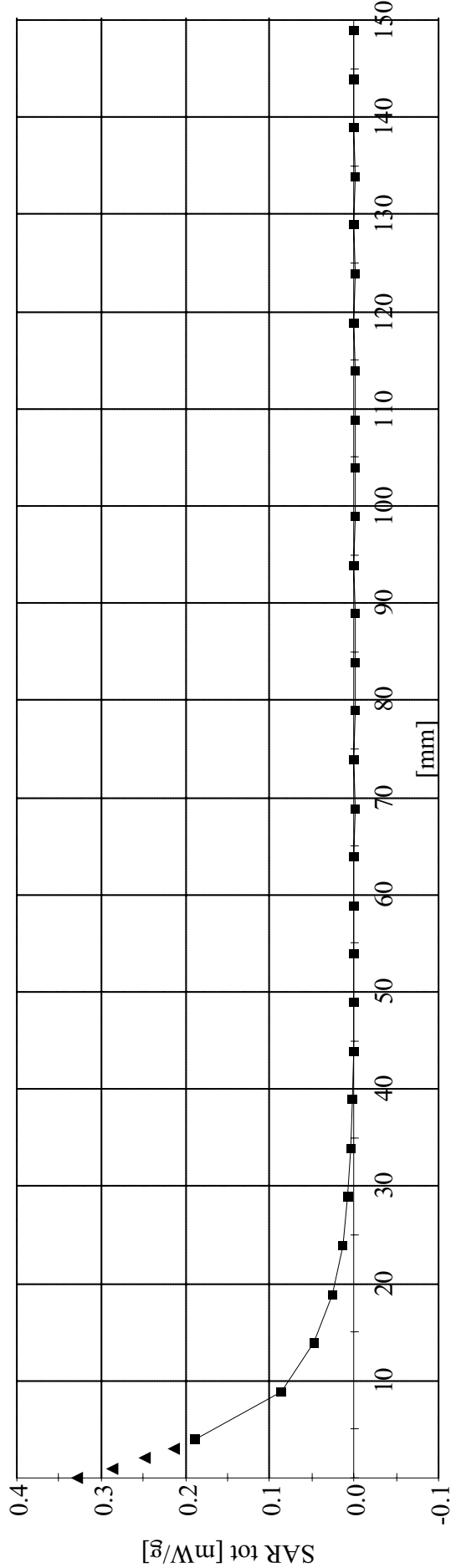
Body SAR - Back of Handset - 0.0 cm Separation Distance
UTS-618 PAS PHS Handset with Ear-Microphone Accessory
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003



UTStarcom Inc. FCC ID: O6YUTS-618
SAM Phantom; Flat Section
Probe: ET3DV6 - SN1387; ConvF(4.90,4.90,4.90); Crest factor: 8.4
1900 MHz Muscle: $\sigma = 1.53 \text{ mho/m}$ $\epsilon_r = 51.3$ $\rho = 1.00 \text{ g/cm}^3$

Z-Axis Extrapolation at Peak SAR Location

Body SAR - Back of Handset - 0.0 cm Separation Distance
UTS-618 PAS PHS Handset with Ear-Microphone Accessory
Fixed Stubby Antenna
3.6V Lithium-ion Battery
TDMA Mode (11.9% Duty Cycle)
Channel 25 (1902.35 MHz)
RF Output Power: 19.63 dBm (EIRP)
Ambient Temp: 25.5°C; Fluid Temp: 23.4°C
Date Tested: June 6, 2003



APPENDIX B - SYSTEM PERFORMANCE CHECK DATA

System Performance Check - 1800MHz Dipole

SAM Phantom; Flat Section

Probe: ET3DV6 - SN1387; ConvF(5.20,5.20,5.20); Crest factor: 1.0; 1800 MHz Brain: $\sigma = 1.35 \text{ mho/m}$ $\epsilon_r = 40.3$ $\rho = 1.00 \text{ g/cm}^3$

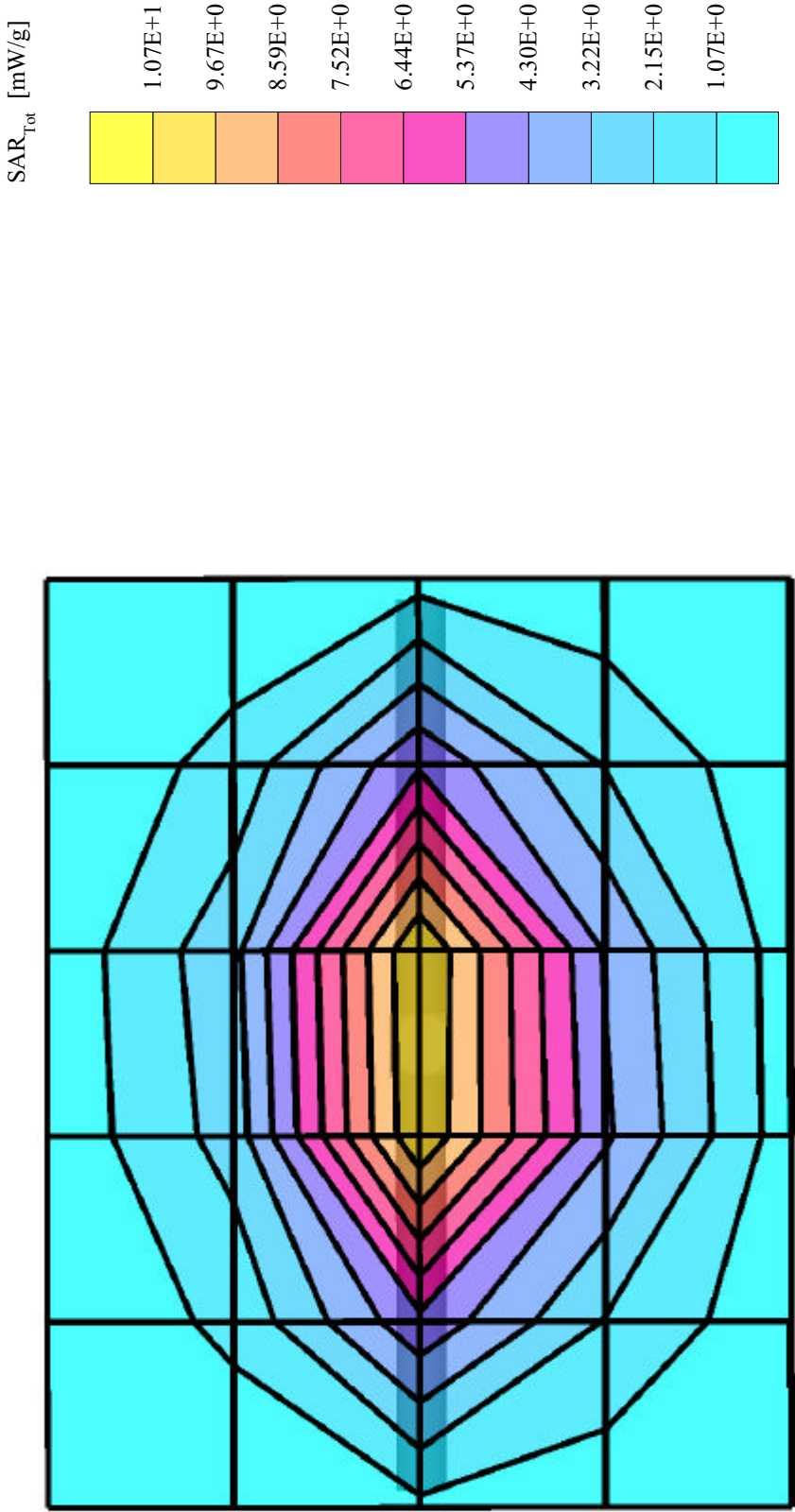
Cube 5x5x7: Peak: 16.2 mW/g, SAR (1g): 9.25 mW/g, SAR (10g): 4.94 mW/g, (Worst-case extrapolation)

Penetration depth: 9.1 (9.0, 9.4) [mm]; Powerdrift: -0.02 dB

Ambient Temp: 25.5°C; Fluid Temp: 23.4°C

Forward Conducted Power: 250 mW

Date Tested: June 6, 2003



APPENDIX C - SYSTEM VALIDATION

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

1800 MHz System Validation Dipole

Type:

D1800V2

Serial Number:

247

Place of Calibration:

Zurich

Date of Calibration:

June 20, 2001

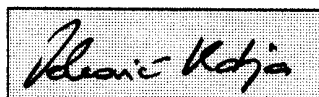
Calibration Interval:

24 months

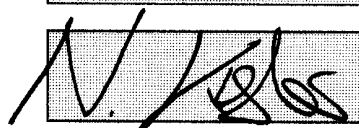
Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:



Approved by:



DASY

Dipole Validation Kit

Type: D1800V2

Serial: 247

Manufactured: August 25, 1999
Calibrated: June 20, 2001

1. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with head simulating glycol solution of the following electrical parameters at 1800 MHz:

Relative Dielectricity	40.0	$\pm 5\%$
Conductivity	1.36 mho/m	$\pm 5\%$

The DASY3 System (Software version 3.1c) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.57 at 1800 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.

The dipole input power (forward power) was 250mW $\pm 3\%$. The results are normalized to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 1. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm³ (1 g) of tissue: **38.64 mW/g**

averaged over 10 cm³ (10 g) of tissue: **20.08 mW/g**

Note: If the liquid parameters for validation are slightly different from the ones used for initial calibration, the SAR-values will be different as well. The estimated sensitivities of SAR-values and penetration depths to the liquid parameters are listed in the DASY Application Note 4: 'SAR Sensitivities'.

3. Dipole Impedance and return loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	1.208 ns	(one direction)
Transmission factor:	0.995	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 1800 MHz:	$\text{Re}\{Z\} = $ 52.4 Ω
----------------------------------	---

	$\text{Im}\{Z\} = $ 0.7 Ω
--	--

Return Loss at 1800 MHz	-32.1 dB
-------------------------	-----------------

4. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with brain sugar-water solution of the following electrical parameters at 1800 MHz:

Relative Dielectricity	40.1	$\pm 5\%$
Conductivity	1.71 mho/m	$\pm 5\%$

The DASY3 System (Software version 3.1c) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.63 at 1800 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.

The dipole input power (forward power) was 250mW $\pm 3\%$. The results are normalized to 1W input power.

5. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 4. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm³ (1 g) of tissue: **43.6 mW/g**

averaged over 10 cm³ (10 g) of tissue: **21.6 mW/g**

Note: If the liquid parameters for validation are slightly different from the ones used for initial calibration, the SAR-values will be different as well. The estimated sensitivities of SAR-values and penetration depths to the liquid parameters are listed in the DASY Application Note 4: 'SAR Sensitivities'.

6. Handling

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

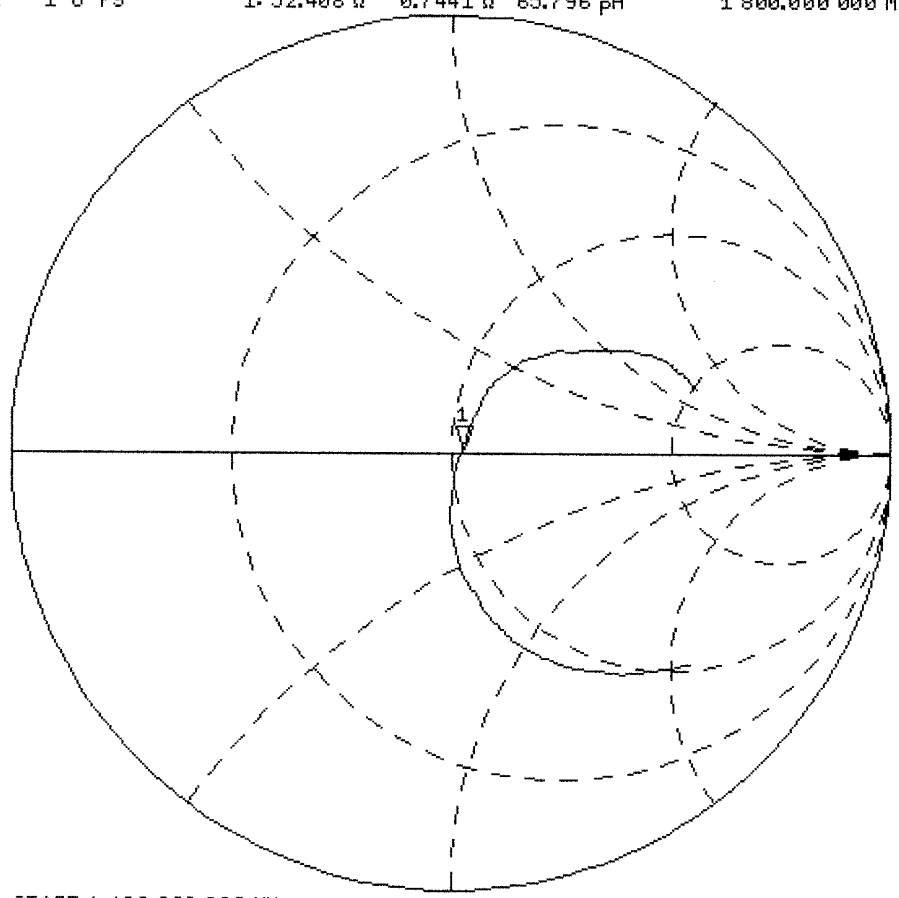
After prolonged use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

20 Jun 2001 15:31:17
[CH1] S11 1 U FS 1: 52.408 Ω 0.7441 Ω 65.796 pH 1 800.000 000 MHz

PRm
Del

Cor

↑

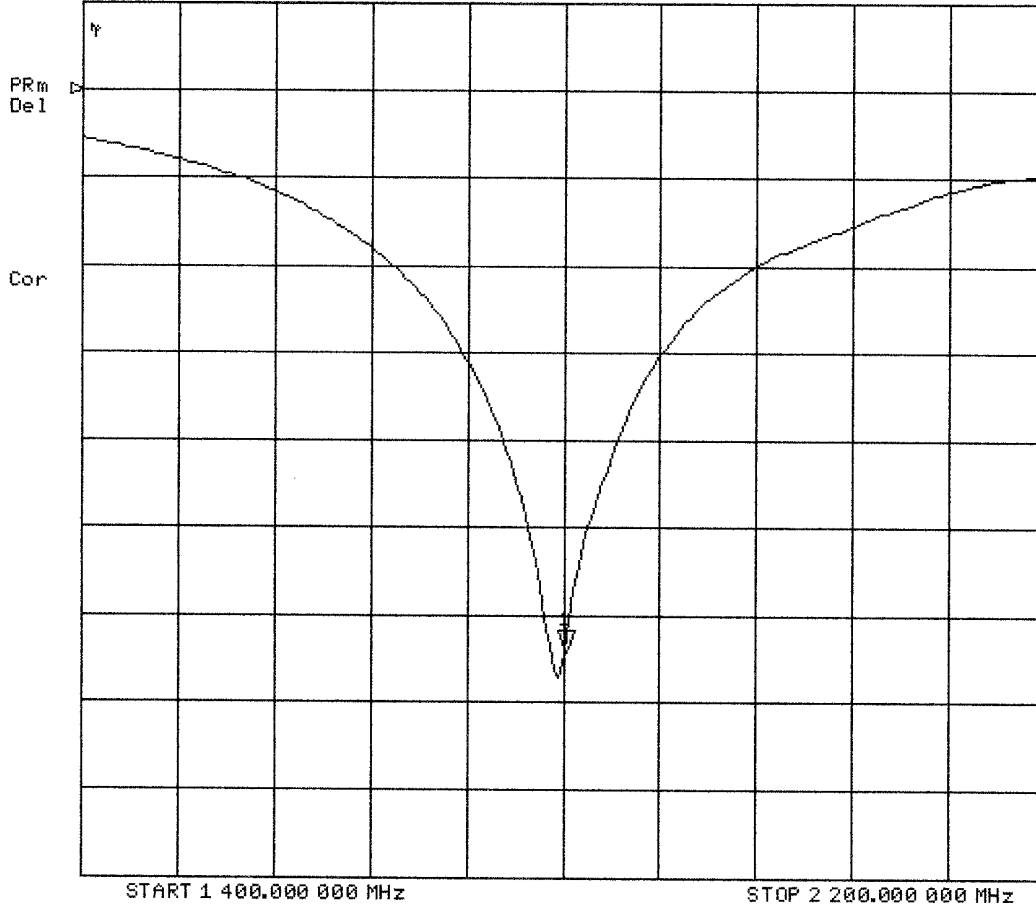


START 1 400.000 000 MHz

STOP 2 200.000 000 MHz

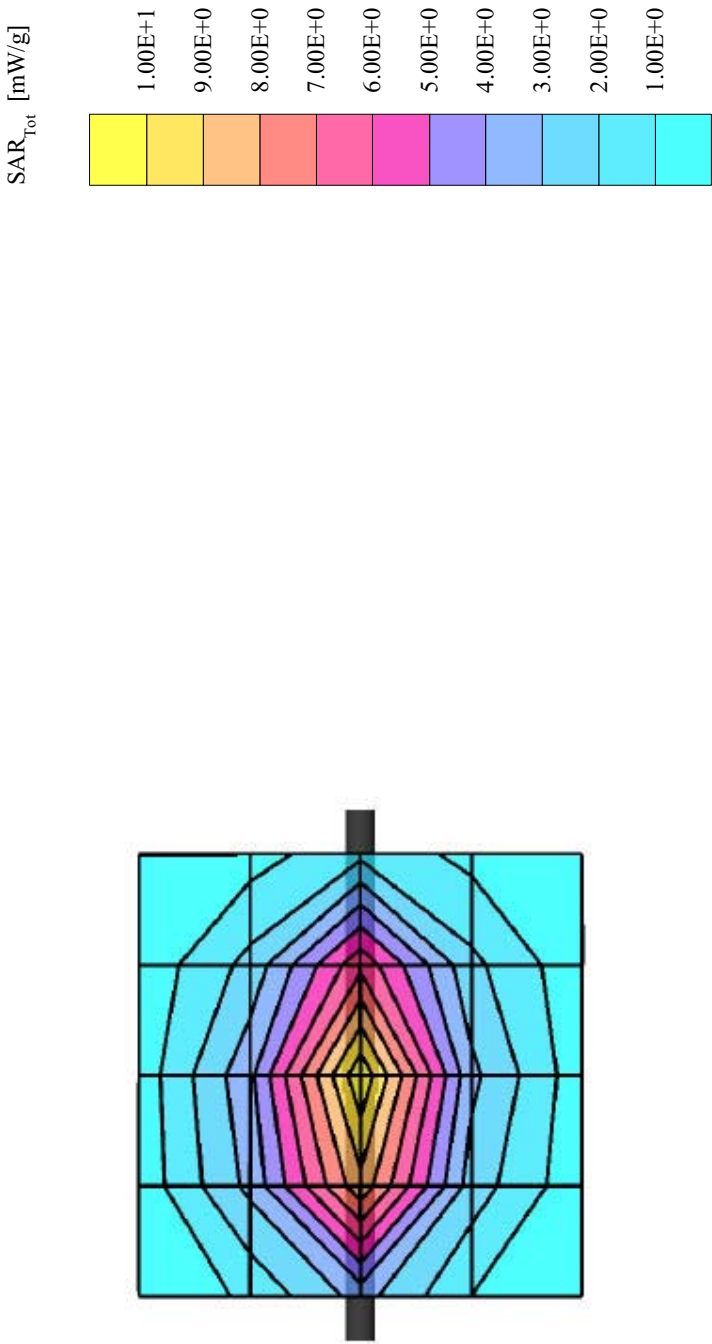
20 Jun 2001 15:31:04

[CH1] S11 LOG 5 dB/REF 0 dB 1:-32.107 dB 1 800.000 000 MHz



Validation Dipole D1800V2 SN:247, d = 10 mm

Frequency: 1800 MHz; Antenna Input Power: 250 [mW]
Generic Twin Phantom; Flat Section; Grid Spacing: Dx = 15.0, Dy = 15.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(5.57,5.57,5.57); Crest factor: 1.0; IEEE1528 1800 MHz : $\sigma = 1.36 \text{ mho/m}$ $\epsilon_r = 40.0$ $\rho = 1.00 \text{ g/cm}^3$
Cubes (2): Peak: 18.2 mW/g $\pm 0.04 \text{ dB}$, SAR (1g): 9.66 mW/g $\pm 0.03 \text{ dB}$, SAR (10g): 5.02 mW/g $\pm 0.03 \text{ dB}$, (Worst-case extrapolation)
Penetration depth: 8.2 (7.6, 9.4) [mm]
Powerdrift: -0.01 dB



APPENDIX D - PROBE CALIBRATION

Client

Celltech Labs

CALIBRATION CERTIFICATE

Object(s)

ET3DV6 - SN: 1387

Calibration procedure(s)

QA CAL-01.v2
Calibration procedure for dosimetric E-field probes

Calibration date:

February 26, 2003

Condition of the calibrated item

In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	8-Mar-02	Mar-03
Power sensor HP 8481A	MY41092180	18-Sep-02	Sep-03
Power meter EPM E4419B	GB41293874	13-Sep-02	Sep-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

Calibrated by:

Name

Nico Vetterli

Function

Technician

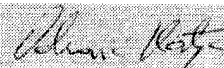
Signature



Approved by:

Katja Pokovic

Laboratory Director



Date issued: February 26, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Probe ET3DV6

SN:1387

Manufactured:	September 21, 1999
Last calibration:	February 22, 2002
Recalibrated:	February 26, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1387

Sensitivity in Free Space

NormX	1.55 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.65 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.64 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	92	mV
DCP Y	92	mV
DCP Z	92	mV

Sensitivity in Tissue Simulating Liquid

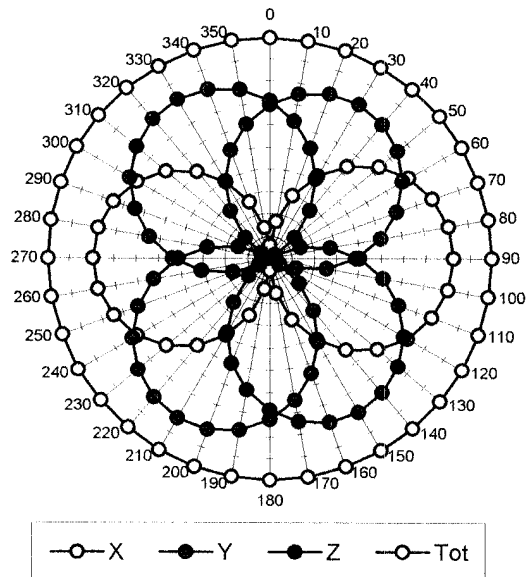
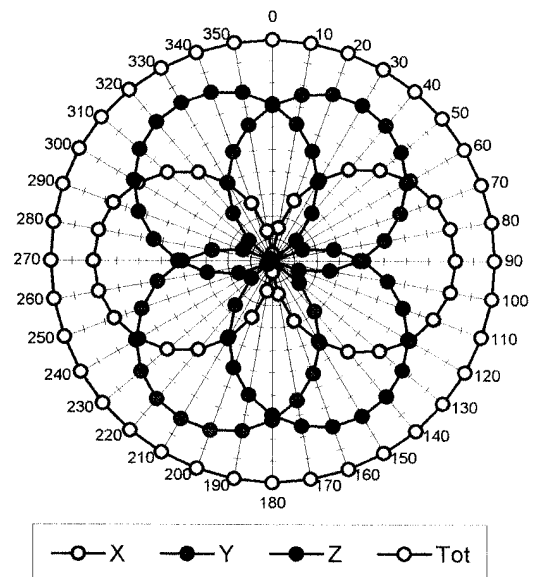
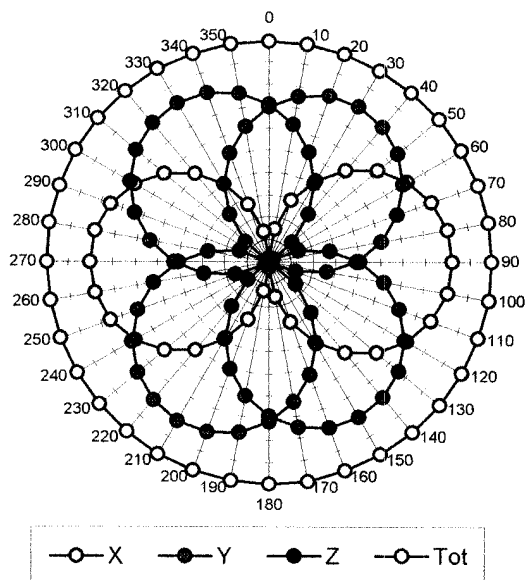
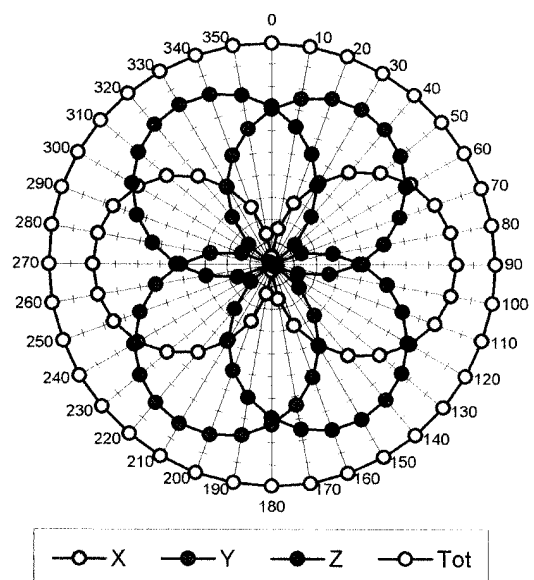
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
ConvF X	6.6 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.6 $\pm 9.5\%$ (k=2)	Alpha	0.37
ConvF Z	6.6 $\pm 9.5\%$ (k=2)	Depth	2.61
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
ConvF X	5.2 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.2 $\pm 9.5\%$ (k=2)	Alpha	0.50
ConvF Z	5.2 $\pm 9.5\%$ (k=2)	Depth	2.73

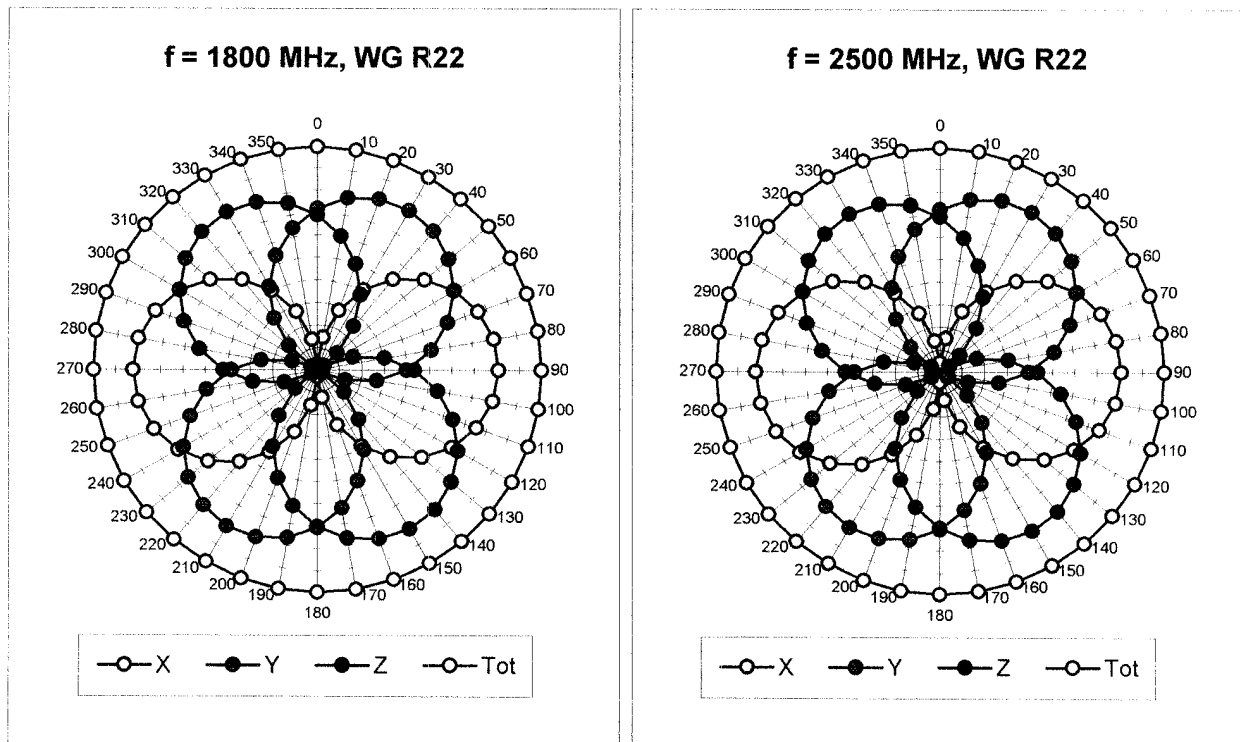
Boundary Effect

Head	900 MHz	Typical SAR gradient: 5 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{pe} [%]	Without Correction Algorithm	10.2	5.9
SAR _{pe} [%]	With Correction Algorithm	0.4	0.6
Head	1800 MHz	Typical SAR gradient: 10 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{pe} [%]	Without Correction Algorithm	14.6	9.8
SAR _{pe} [%]	With Correction Algorithm	0.2	0.0

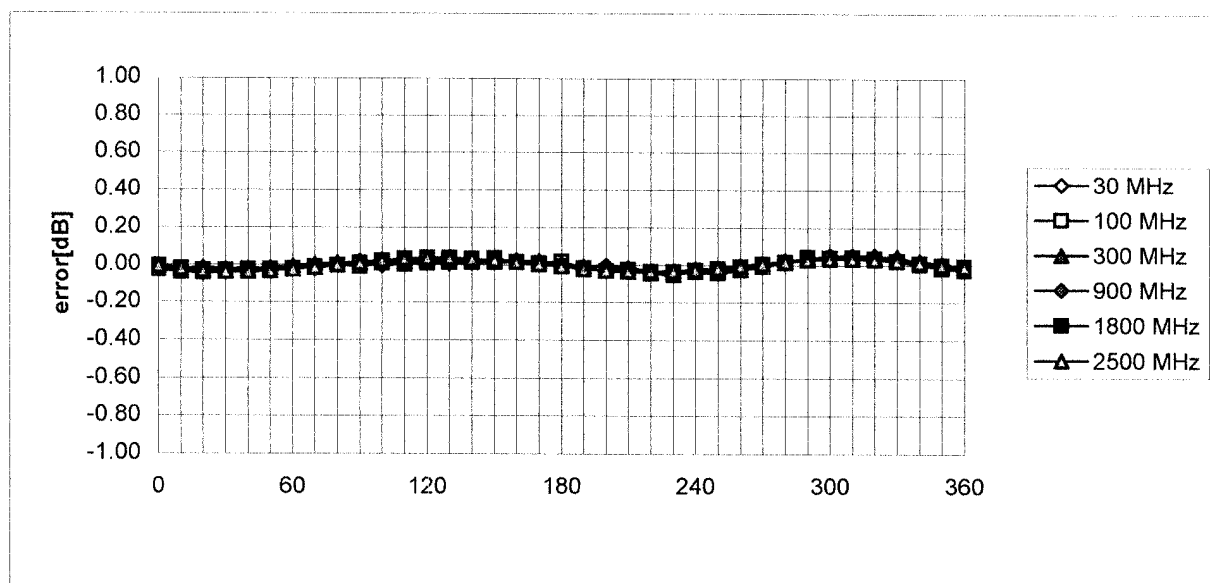
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.4 $\pm$ 0.2	mm

Receiving Pattern (ϕ), $\theta = 0^\circ$ **f = 30 MHz, TEM cell ifi110****f = 100 MHz, TEM cell ifi110****f = 300 MHz, TEM cell ifi110****f = 900 MHz, TEM cell ifi110**

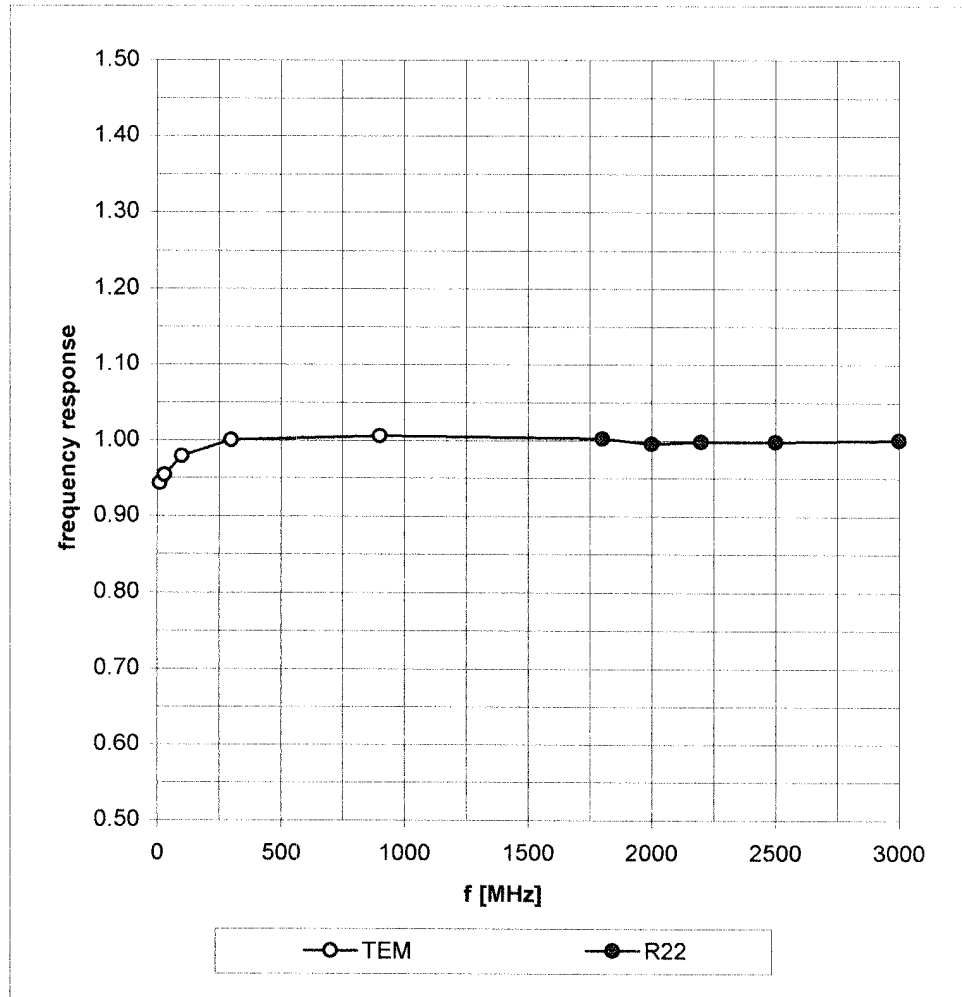


Isotropy Error (ϕ), $\theta = 0^\circ$

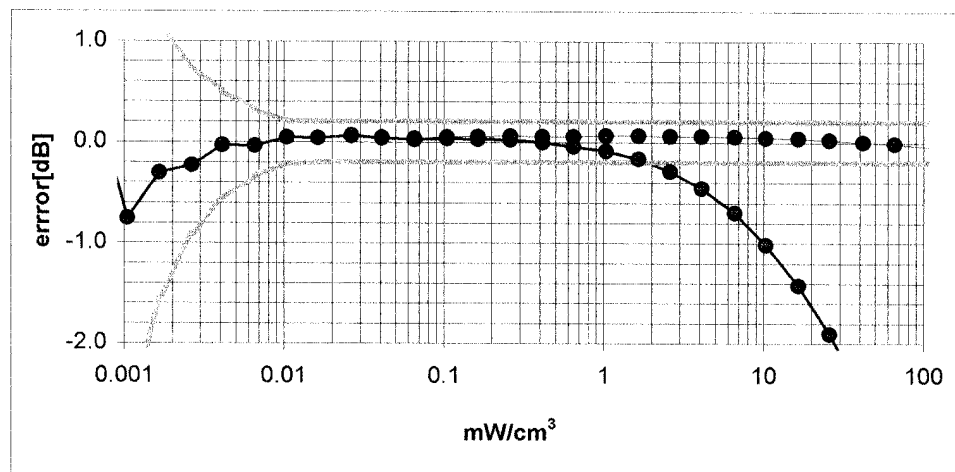
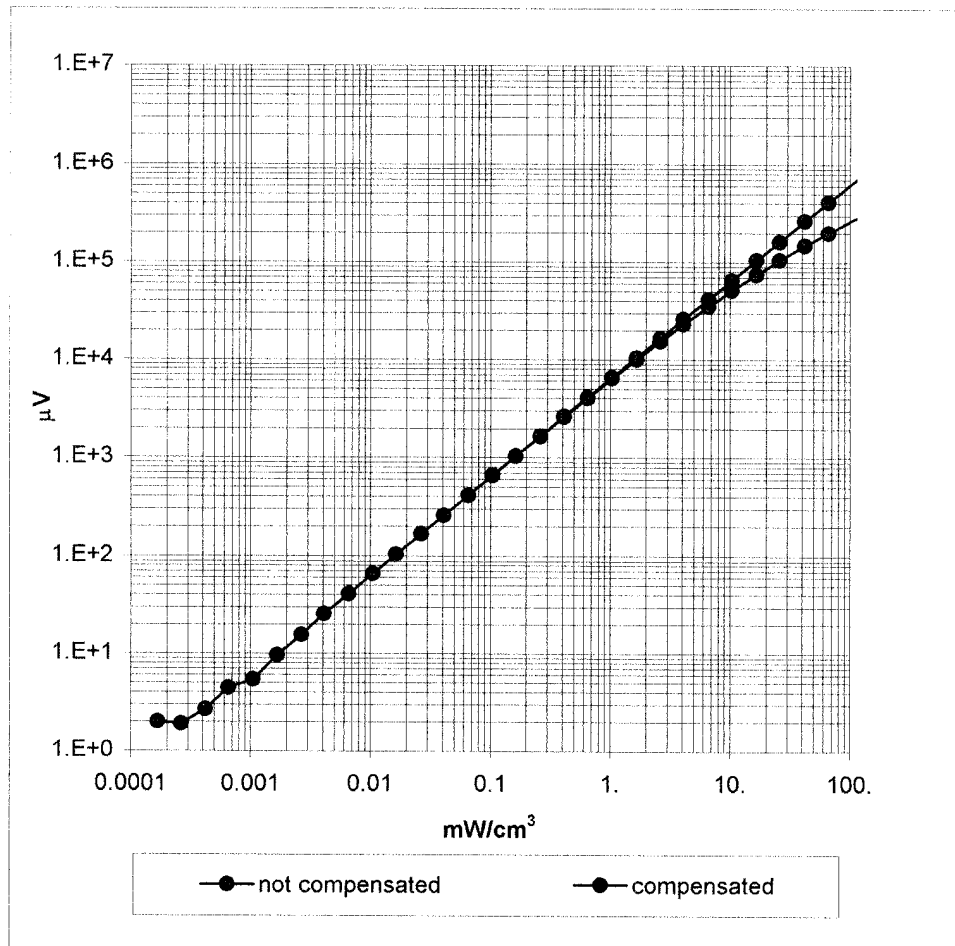


Frequency Response of E-Field

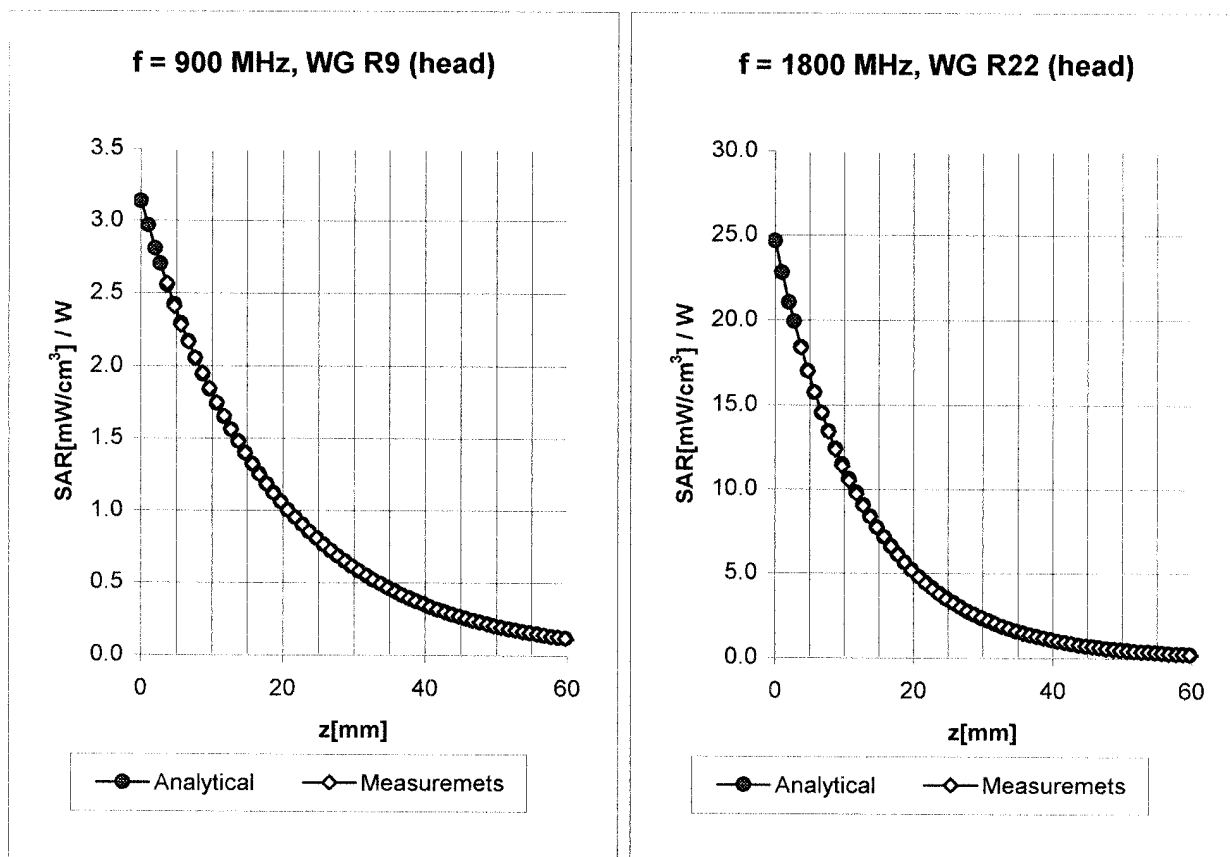
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range f(SAR_{brain}) (Waveguide R22)

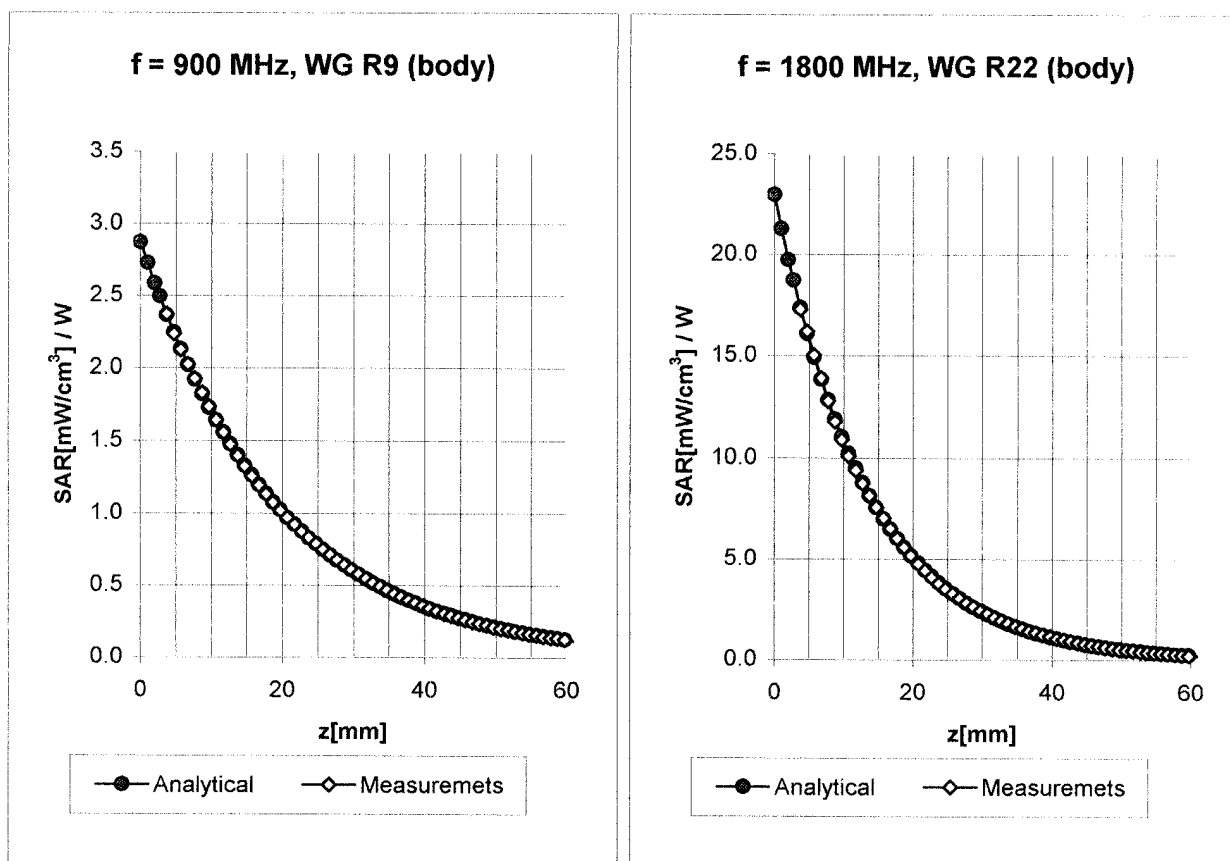


Conversion Factor Assessment



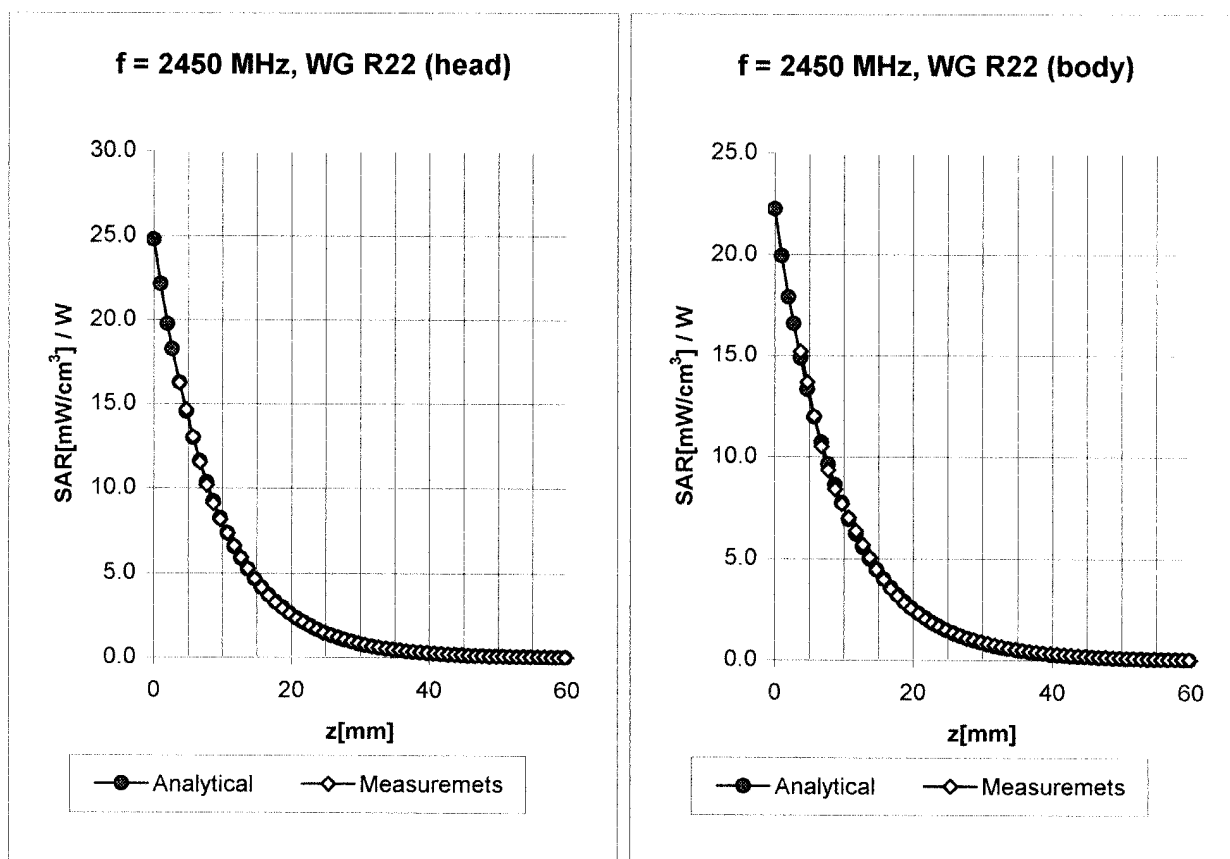
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
	ConvF X	6.6 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	6.6 $\pm 9.5\%$ (k=2)	Alpha 0.37
	ConvF Z	6.6 $\pm 9.5\%$ (k=2)	Depth 2.61
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
	ConvF X	5.2 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	5.2 $\pm 9.5\%$ (k=2)	Alpha 0.50
	ConvF Z	5.2 $\pm 9.5\%$ (k=2)	Depth 2.73

Conversion Factor Assessment



Body	900 MHz	$\epsilon_r = 55.0 \pm 5\%$	$\sigma = 1.05 \pm 5\% \text{ mho/m}$
Body	835 MHz	$\epsilon_r = 55.2 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
	ConvF X	6.4 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	6.4 $\pm 9.5\%$ (k=2)	Alpha 0.45
	ConvF Z	6.4 $\pm 9.5\%$ (k=2)	Depth 2.35
Body	1800 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
Body	1900 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
	ConvF X	4.9 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	4.9 $\pm 9.5\%$ (k=2)	Alpha 0.60
	ConvF Z	4.9 $\pm 9.5\%$ (k=2)	Depth 2.59

Conversion Factor Assessment



Head 2450 MHz $\epsilon_r = 39.2 \pm 5\%$ $\sigma = 1.80 \pm 5\%$ mho/m

ConvF X **5.0** $\pm 8.9\%$ (k=2)

Boundary effect:

ConvF Y **5.0** $\pm 8.9\%$ (k=2)

Alpha **1.04**

ConvF Z **5.0** $\pm 8.9\%$ (k=2)

Depth **1.85**

Body 2450 MHz $\epsilon_r = 52.7 \pm 5\%$ $\sigma = 1.95 \pm 5\%$ mho/m

ConvF X **4.6** $\pm 8.9\%$ (k=2)

Boundary effect:

ConvF Y **4.6** $\pm 8.9\%$ (k=2)

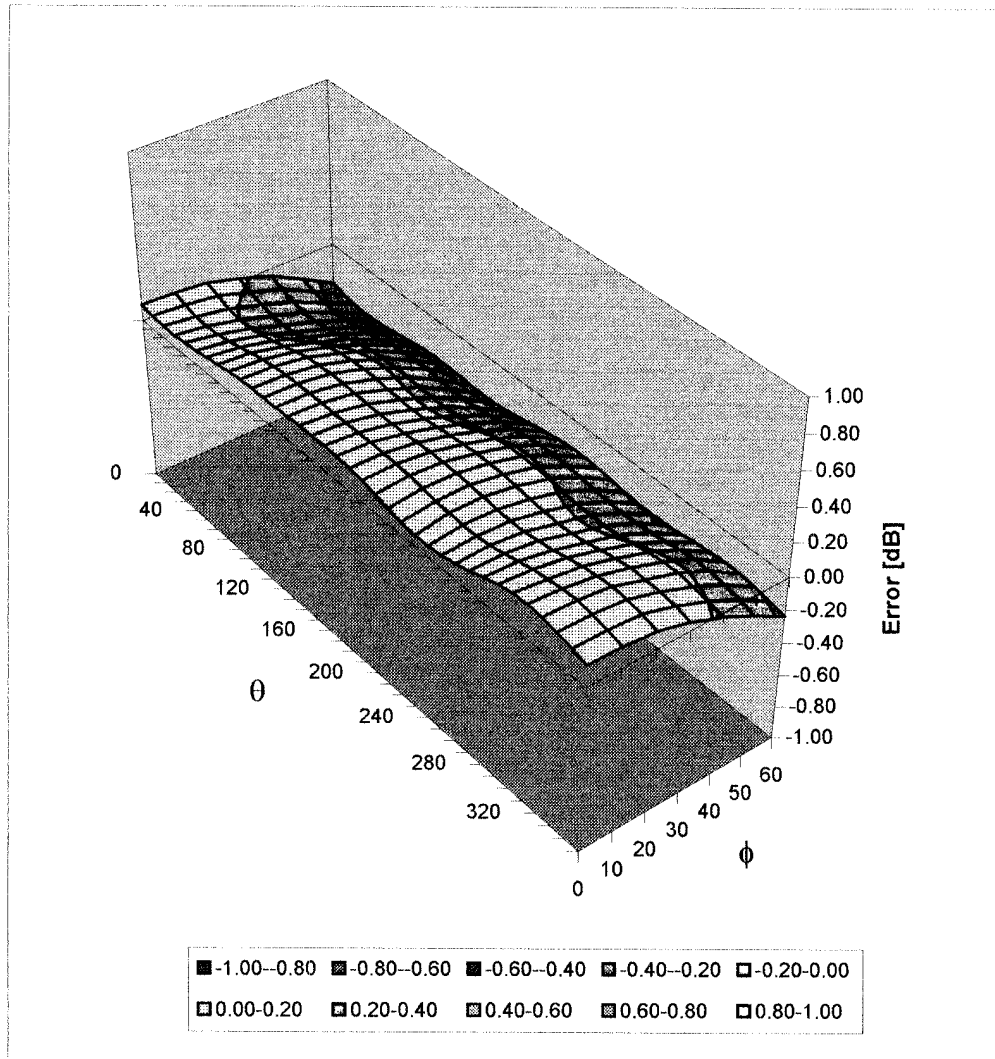
Alpha **1.20**

ConvF Z **4.6** $\pm 8.9\%$ (k=2)

Depth **1.60**

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1387

Place of Assessment:

Zurich

Date of Assessment:

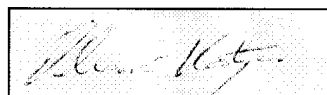
February 28, 2003

Probe Calibration Date:

February 26, 2003

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:



Dosimetric E-Field Probe ET3DV6 SN:1387

Conversion factor ($\pm$ standard deviation)

150 MHz	ConvF	$9.1 \pm 8\%$	$\epsilon_r = 52.3$ $\sigma = 0.76 \text{ mho/m}$ (head tissue)
300 MHz	ConvF	$7.9 \pm 8\%$	$\epsilon_r = 45.3$ $\sigma = 0.87 \text{ mho/m}$ (head tissue)
450 MHz	ConvF	$7.5 \pm 8\%$	$\epsilon_r = 43.5$ $\sigma = 0.87 \text{ mho/m}$ (head tissue)
150 MHz	ConvF	$8.8 \pm 8\%$	$\epsilon_r = 61.9$ $\sigma = 0.80 \text{ mho/m}$ (body tissue)
300 MHz	ConvF	$8.0 \pm 8\%$	$\epsilon_r = 58.2$ $\sigma = 0.92 \text{ mho/m}$ (body tissue)
450 MHz	ConvF	$7.7 \pm 8\%$	$\epsilon_r = 56.7$ $\sigma = 0.94 \text{ mho/m}$ (body tissue)

APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

1800MHz System Performance Check

Measured Fluid Dielectric Parameters (Brain)

June 06, 2003

Frequency	ϵ'	ϵ''
1.700000000 GHz	40.6376	13.2351
1.710000000 GHz	40.6142	13.2359
1.720000000 GHz	40.5758	13.2518
1.730000000 GHz	40.5474	13.2774
1.740000000 GHz	40.4994	13.2990
1.750000000 GHz	40.4785	13.3480
1.760000000 GHz	40.4340	13.3863
1.770000000 GHz	40.4068	13.4202
1.780000000 GHz	40.3631	13.4550
1.790000000 GHz	40.3324	13.4786
1.800000000 GHz	40.2669	13.5085
1.810000000 GHz	40.2227	13.5407
1.820000000 GHz	40.1562	13.5593
1.830000000 GHz	40.1198	13.6143
1.840000000 GHz	40.0815	13.6250
1.850000000 GHz	40.0371	13.6579
1.860000000 GHz	40.0025	13.6755
1.870000000 GHz	39.9669	13.6849
1.880000000 GHz	39.9277	13.7058
1.890000000 GHz	39.8851	13.7289
1.900000000 GHz	39.8275	13.7500

1900MHz EUT Evaluation (Head SAR)

Measured Fluid Dielectric Parameters (Brain)

June 06, 2003

Frequency	ϵ'	ϵ''
1.800000000 GHz	38.7797	13.0025
1.810000000 GHz	38.7334	13.0286
1.820000000 GHz	38.6792	13.0445
1.830000000 GHz	38.6326	13.0709
1.840000000 GHz	38.6206	13.1034
1.850000000 GHz	38.5749	13.1176
1.860000000 GHz	38.5401	13.1283
1.870000000 GHz	38.4933	13.1464
1.880000000 GHz	38.4641	13.1628
1.890000000 GHz	38.4286	13.2006
1.900000000 GHz	38.3987	13.2263
1.910000000 GHz	38.3579	13.2704
1.920000000 GHz	38.3293	13.3040
1.930000000 GHz	38.2820	13.3290
1.940000000 GHz	38.2498	13.3622
1.950000000 GHz	38.2234	13.3800
1.960000000 GHz	38.1730	13.3901
1.970000000 GHz	38.1252	13.4073
1.980000000 GHz	38.0753	13.4463
1.990000000 GHz	38.0198	13.4748
2.000000000 GHz	37.9717	13.5216

1900MHz EUT Evaluation (Body SAR)

Measured Fluid Dielectric Parameters (Muscle)

June 06, 2003

Frequency	e'	e''
1.800000000 GHz	51.6896	14.2281
1.810000000 GHz	51.6723	14.2583
1.820000000 GHz	51.5979	14.2903
1.830000000 GHz	51.5729	14.3236
1.840000000 GHz	51.5187	14.3537
1.850000000 GHz	51.4833	14.3786
1.860000000 GHz	51.4419	14.3985
1.870000000 GHz	51.3975	14.4211
1.880000000 GHz	51.3552	14.4603
1.890000000 GHz	51.3324	14.4790
1.900000000 GHz	51.2950	14.5074
1.910000000 GHz	51.2508	14.5420
1.920000000 GHz	51.2180	14.5633
1.930000000 GHz	51.2192	14.5971
1.940000000 GHz	51.1940	14.6191
1.950000000 GHz	51.1576	14.6268
1.960000000 GHz	51.1398	14.6533
1.970000000 GHz	51.1032	14.6689
1.980000000 GHz	51.0612	14.7075
1.990000000 GHz	51.0233	14.7639
2.000000000 GHz	51.0015	14.8164

APPENDIX F - SAM PHANTOM CERTIFICATE OF CONFORMITY

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 BA
Series No	TP-1002 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

Tests

The series production process used allows the limitation to test of first articles. Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards	Liquid type HSL 1800 and others according to the standard.	Pre-series, First article

Standards

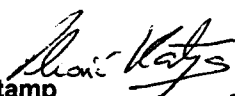
- [1] CENELEC EN 50361
- [2] IEEE P1528-200x draft 6.5
- [3] IEC PT 62209 draft 0.9
- (*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 18.11.2001

Signature / Stamp



**Schmid & Partner
Engineering AG**



Zeughausstrasse 43, CH-8004 Zurich
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

APPENDIX G - SAR TEST SETUP & EUT PHOTOGRAPHS

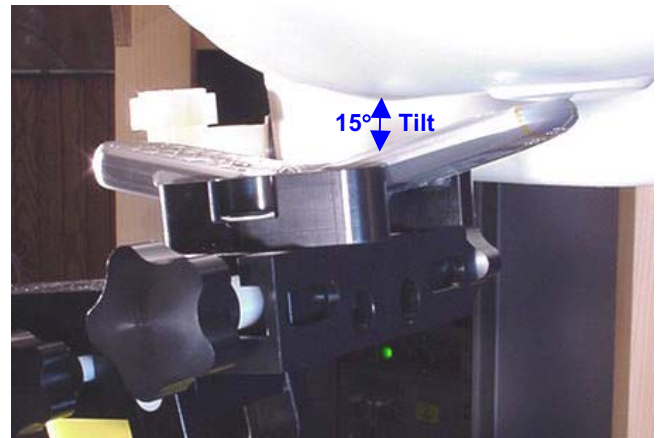
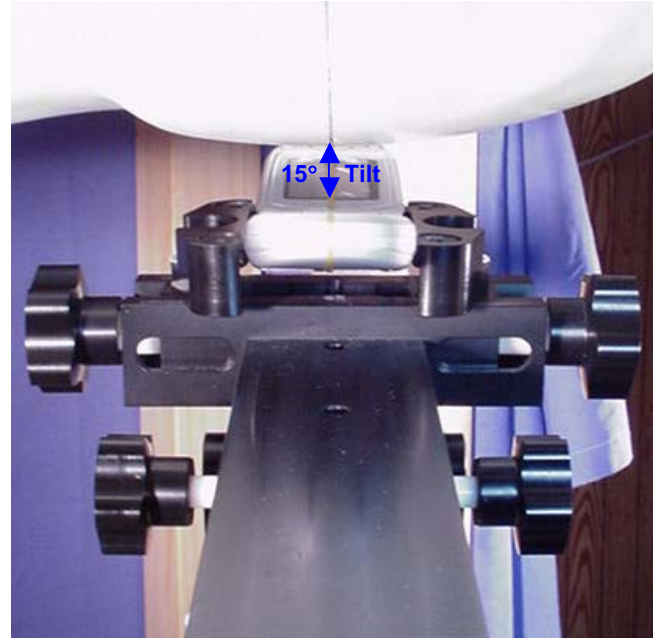
SAR TEST SETUP PHOTOGRAPHS

Left Head Section / Cheek-Touch Position



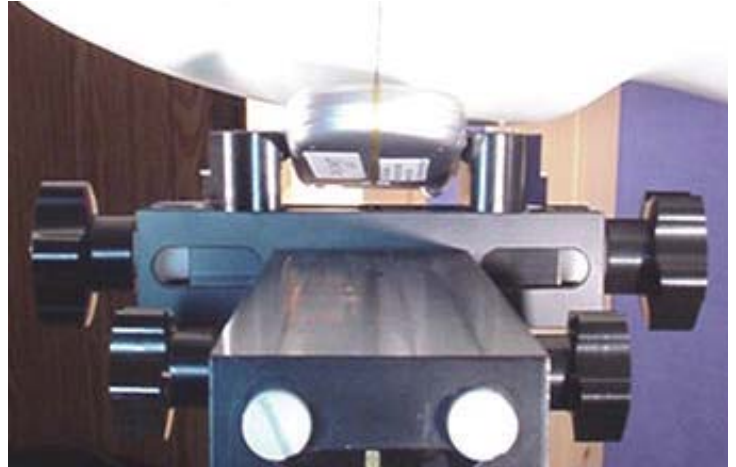
SAR TEST SETUP PHOTOGRAPHS

Left Head Section / 15° Ear-Tilt Position



SAR TEST SETUP PHOTOGRAPHS

Right Head Section / Cheek-Touch Position



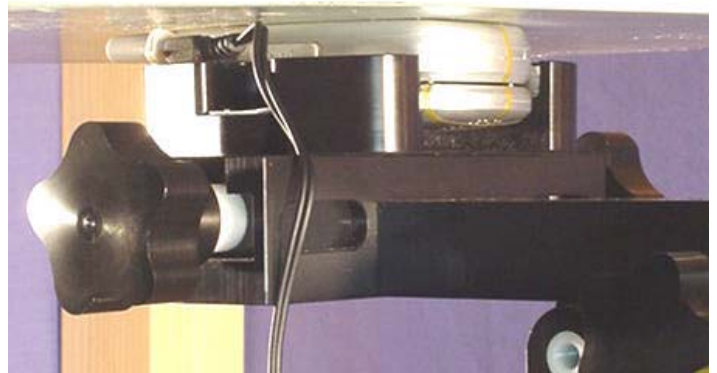
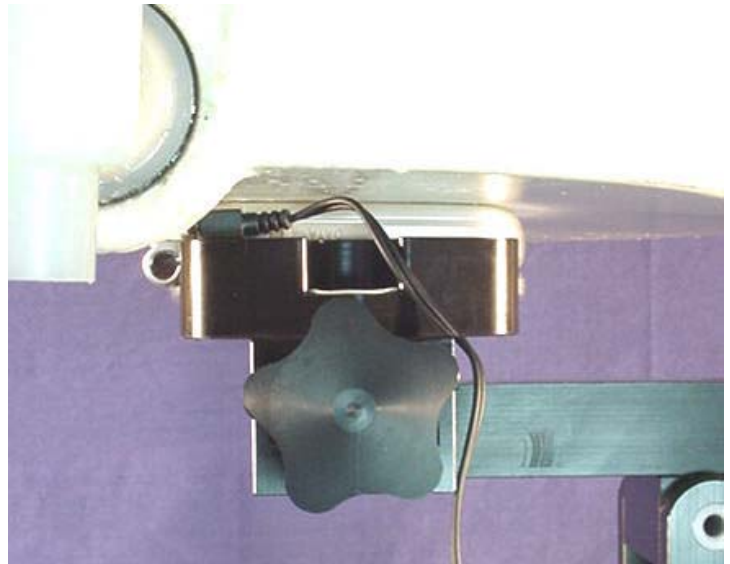
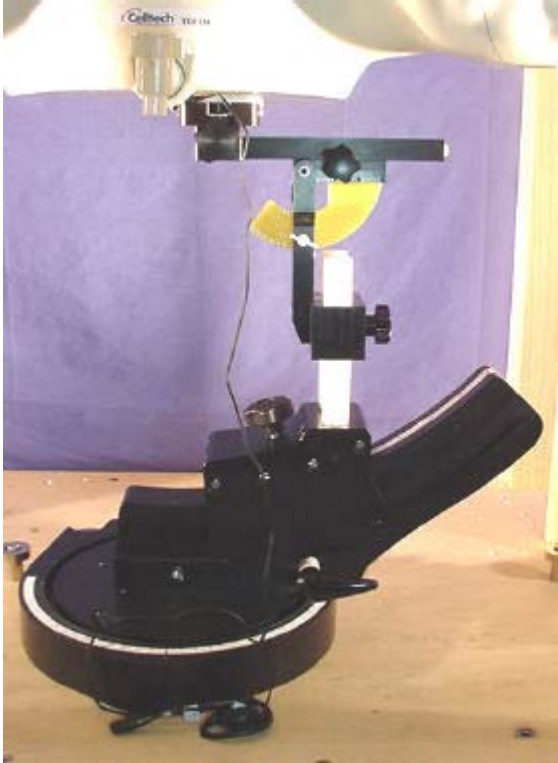
SAR TEST SETUP PHOTOGRAPHS

Right Head Section / 15° Ear-Tilt Position



SAR TEST SETUP PHOTOGRAPHS

Body SAR / 0.0 cm Separation Distance from Back of EUT to Planar Phantom



EXTERNAL EUT PHOTOGRAPHS



EXTERNAL EUT PHOTOGRAPHS



EXTERNAL EUT PHOTOGRAPHS

